nsca

CLEAN AIR

AND ENVIRONMENTAL PROTECTION

SPRING 1995

Volume 25 Number One

NATIONAL SOCIETY FOR CLEAN AIR
AND ENVIRONMENTAL PROTECTION

SPRING 1995
VOLUME 25
ISSN 0300-5734

CLEAN AIR

nsca

Publishing Director:
Dr. Tom Crossett
Secretary General, NSCA

Editor:
Loveday Murley

Information/PRO:
Tim Brown

Advertising:
Sally May
Rates on request.

CLEAN AIR is issued free to Members and Representatives of Members.

CLEAN AIR Subscription for 1995 — £24.00

CLEAN AIR is printed and published in England by the National Society for Clean Air and Environmental Protection, 136 North Street
Brighton BN1 1RG
Tel: 01273 326313
Fax: 01273 735802

CONTENTS

EDITORIAL

CLIMATE CHANGE – TOP DOWN OR BOTTOM UP?

Maturation of environmental issues often involves three stages:

1. There isn't a problem.
2. There is a problem, and its cause is so intimately bound up with our way of life that we can't do anything about it.
3. Unless we deal with the problem, we won't have a way of life.

Once stage three is reached, action can be radical and rapid, as we have seen with atmospheric testing of nuclear weapons, organochlorine pesticides, and ozone depleting substances. The outcome of the meeting of parties to the Climate Change Convention in Berlin suggests that climate change remains firmly at stage two. On the face of it this may be reasonable, because although signatories to the Convention are committed to stabilise greenhouse gases at concentrations that would avoid dangerous human interference with the climate system, it is impossible to define what the objective means in quantitative terms. However, the Convention requires signatories to take precautionary measures and not to delay action for want of full scientific evidence where there is threat of serious or irreversible damage.

Little was achieved in Berlin because the governments of developed countries lack confidence to confront their electorates with the realities of the world which their children will inhabit. Sir John Houghton, former Director of the UK Meteorological Office and Chairman of the Royal Commission on Environmental Pollution and the Scientific Working Group of the InterGovernmental Panel on Climate Change, has given a personal view of the way in which we could deal with the median in current scientific evidence. This would involve stabilising global atmospheric CO_2 concentrations at twice the industrial values, a target which the World Energy Council considers to be feasible. It would require developed countries to reduce emissions by 20% over the coming 25 years, but permit developing countries to double theirs to allow for population growth and economic development. After that, serious cuts would be required to reduce global emissions to half current levels by 2100.

There can be no doubt that the most probable scenario lacks electoral appeal, but it is likely that we will have to face it sooner or later. The longer we leave it, the more radical will be the necessary change, and the less its electoral appeal.

The UK has gone to Berlin in a position which is superficially much stronger than other developed countries. It appears that we shall easily meet our target of stabilising carbon dioxide emissions at their 1990 level by the year 2000. We have done this by

burning more natural gas and less coal than we expected to generate our electricity. Otherwise, it is business as usual, and many of the energy efficiency measures we trumpeted earlier have failed to materialise. We therefore stand at a considerable disadvantage as far as action at the beginning of the next century is concerned.

One promising initiative at Berlin has achieved little attention. Municipal leaders from 159 Local Authorities in 65 countries have produced a much more ambitious agenda for action at local level. Speaking on behalf of 250 million people, they wish to see carbon dioxide emissions by the year 2005 at 80% of their 1990 level. They also wish to see specific timetables and targets for other greenhouse gases, incentives for renewable energy sources and energy conservation. In the face of inaction by national Governments, they want to see devolution of responsibility because they believe that they have the backing of their electorates to safeguard their children's future. They also know energy efficiency is the winning option.

We have long believed that local energy planning has an enormous potential for improving quality of life and reducing stress on the environment and natural resources. Local energy management is a natural partner to local air quality management, and the prospect of a new Home Energy Conservation Act will give local authorities a real incentive to get involved. We have applauded initiatives like those taken in Newcastle on Tyne and Leicester, and believe that the UK should now take the leadership in the climate change area, not only by strong action at national level but by delegation of responsibilities and resources to ensure that an energy mix appropriate to local circumstances is reached as quickly and effectively as possible.

Copies of the Municipal leaders declaration are available from the Editor on request.

NSCA VIEWS

LOCAL AIR QUALITY MANAGEMENT

Following publication of the Department of Environment discussion paper *Improving Air Quality,* NSCA commissioned Dr Duncan Laxen to survey local authority pollution co-ordinating groups, and other organisations with an interest in local air quality management (LAQM), to establish their views on the development of LAQM. The survey work was jointly funded by DOE.

Dr Laxen presented his conclusions to a meeting of the NSCA's LAQM Information Exchange Network on 17 October 1994; DOE AQ officials have also been briefed on the survey results.

Following discussion of Dr Laxen's report, the NSCA LAQM Network formulated the following recommendations which have now been adopted as Society policy:

1. In order to secure integrated and rational management of both local sources of air pollution and transboundary pollutants, as well as securing the cost effectiveness advantages of central initiatives where appropriate, legislation should be introduced which requires a formal approach to AQ management and planning at a local level. It would be appropriate to link the introduction of this legislation with the proposed EU Framework Directive on Ambient Air Quality Assessment and Management. The Society should therefore seek also an appropriate UK response to EU Commission proposals.
2. In view of the volume of work already in progress on LAQM, the urgent need to tackle air pollution problems in some geographical areas, and the benefits which practical experience brings to the development of regulations, initial guidance on LAQM should be developed in advance of legislation.
3. Legislation should require a Review of local AQ in relation to current standards as the first stage in the preparation of an AQ Plan which proposes a timetable for attainment of standards in areas where they are exceeded and/or it is demonstrated that projected development would lead to a deterioration in AQ.
4. Both the Review and the Plan should be subject to consultation with the public and bodies defined in statute. The Plan should be self-certified for compliance with guidance by the originating authority, subject to public inquiry.
5. Responsibility for the Review and Plan would rest with lower-tier or unitary authorities. They should have an obligation to consult on transboundary issues. They should also be encouraged to set up collaborative arrangements wherever appropriate.

6. The pollution levels and extent of monitoring required to trigger particular air quality management measures necessary to protect specific aspects of health, or conservation of heritage and biodiversity involve consideration of complex issues. It will probably be necessary to go beyond the concepts outlined in *Improving Air Quality* and the Framework Directive. Consultation will be required before useful guidance could be produced.

7. Individual LAs should take into account pollution sources in the surrounding area as well as the impact of their own sources on surrounding areas. Authorities should be encouraged to set up voluntary collaborative groups which bring together relevant disciplines including those which have strong links with the planning process. The AQM Plan might be seen as an overlay on the planning process, and the ideal collaborative arrangement would reflect elements of the current LA air pollution co-ordinating groups and those with wider interests, such as SERPLAN and Local Agenda 21 fora.

8. As a matter of urgency, DOE should foster preparation of guidance on all aspects of LAQM including the form and content of Reviews and Plans, the individual techniques such as compilation of emissions inventories, interpretative modelling and monitoring, as well as factors to be taken into account when establishing collaborative arrangements. The Department might prepare this guidance itself, either in-house or through contractors; it might establish a quango for the purpose; or it might do it through the good offices of an independent body. The Society should be prepared to take on the third task, subject to acquisition of resources for a viable secretariat of two specialist staff for a period of two years. Their role would be to prepare draft guidance in all relevant areas, working in consultation with the local authority associations, professional bodies and other relevant interests.

9. Guidance on modelling should include descriptions of best practice for appropriate types of area.

10. Guidance on interpretative modelling should be comprehensive and address issues relating to input data, processing and analysis of output.

11. In all guidance, appropriate note should be taken of the need for quality assurance and control, and review and assessment.

12. Guidance on arrangements for organisation in individual authorities should not be prescriptive. Authorities should be regarded as having general competence in AQM. It would be for individual decision, however, whether there should be an AQ manager or an AQM responsibility vested in a number of posts.

It is clear from the soundings taken from LA groupings that any requirement for LAQM must be underpinned by a statutory responsibility for borough, district or unitary LAs to prepare a LAQM Plan. As a result of NSCA campaigning, it is expected that an appropriate clause will be added to the Environment Bill, currently before Parliament (see next article).

ENVIRONMENT BILL

NSCA welcomed the Government's promise to add a national strategy for air pollution, and wide-ranging new air pollution control powers for local authorities, to the Environment Bill. The concession came in response to an amendment tabled by NSCA President Lord Lewis and Vice-President Lord Nathan, during the Bill's Lords Committee Stage on 9 February.

The Department of Environment will now bring forward its own amendment to introduce a national strategic plan and standards for air quality, linked to a statutory framework for local air quality management focussed on areas of risk. All local authorities will have a duty to review local air quality and new powers may be made available to assist with air quality management.

Central guidance will be issued on techniques for assessing air quality, criteria for identifying air quality management areas, methods for managing air quality, and monitoring.

NSCA will continue to monitor the proposals. In particular we are concerned that the guidance should show how local air quality management strategies are assessed for cost-effectiveness, and how they integrate with broader development, transport and energy planning. We also want to ensure that any new duties on local authorities are fully resourced.

UK RURAL WHITE PAPER

This White Paper has been prepared jointly by the Department of Environment and Ministry of Agriculture, Fisheries and Food. It aims to present a long-term strategic vision of the countryside into the next century, taking account of the Government's Sustainable Development Strategy.

NSCA Comments

Introduction

The Society welcomes Government's intention to put forward a long term strategic vision of the countryside in the context of the strategy for sustainable development.

Obviously the sharpness of that vision must decrease with distance into the future. Accordingly we agree that there should be specific proposals for the first decade of the next century. In addition, following the example of the landscape designers of the 18th century and the traditions of good farming, it should look two or three generations ahead. Only on such a timescale can we afford to renew much of the rural infrastructure; therefore it is vital that the clearest possible guidance should be given to planners and investors now. The aim must be to ensure that development follows a path as close as possible to the optimum.

Integration

As elsewhere, rural affairs have suffered from the subject divisions in Government policy and splits in responsibility. We need to mend this and emphasise the interconnectedness of issues. In particular, air quality has often only been considered as an urban issue when clearly the effects are felt in rural areas (notably through acid deposition and the creation of stratospheric ozone and its harm to plant and animal life). The causes of pollution are also due to activities which take place in rural areas, having been displaced from urban areas, such as the growth in longer-distance journeys by car to out-of-town stores and distant leisure. Whilst the impact of agriculture on water quality has been appreciated for some time we are also now becoming more aware of the industry's effects on air quality and a more positive approach to emissions of methane and ammonia will be needed.

Importance of Local Solutions

As the letter to consultees suggests, one key area is the need to address the relationship between town and country. With transport as the biggest environmental issue for the foreseeable future, we need not only to find innovative ways to encourage reductions in travel by individuals but also to encourage individuals to lessen the transport implications of their consumer choices. We all need to buy locally produced goods and support local solutions to problems such as waste disposal. In the short and medium terms support for the consumption of locally produced goods will also help to conserve the character, flora and fauna of each part of the countryside. Support for local solutions to the prevention and disposal of waste will foster community responsibility to problems that we all have a part in creating. European policy and initiatives need to recognise the functional relationship between town and country. Current discussion of "Sustainable Cities" is plainly absurd when alone they can never be sustainable without their hinterland.

As the Royal Commission on Environmental Pollution has concluded from "a large amount of often confusing evidence" in paragraph 9.36 of its 18th Report, *"Transport and the Environment"* (Cm 2674)

> ". . .there is no single pattern of land uses that will reduce the need to travel and so reduce the effects of transport on the environment. Nevertheless some important principles emerge. A range of settlement patterns, including compact, centralised cities and small to moderate-sized towns or urban villages with a good mix of employment and services, has the potential to offer efficiency, access and choice. The size of settlement and precise arrangement of land uses could never be planned solely on grounds of transport efficiency but avoidance of obviously travel-intensive development patterns would be a significant improvement on the present situation. Land use planning has a role here but there are two important qualifications. Bringing different land uses into closer proximity is a necessary but not a sufficient condition for reducing travel demand; and the economic and social costs of mobility may have to be internalised first, before it becomes 'economic' to provide more local facilities."

When addressing the question of rural settlement policy we hope that the White

Paper will build on the work of the Royal Commission to begin developing guidance on the circumstances where it is sensible to encourage development and diversification of the rural economy in order to support existing patterns of rural settlement as opposed to providing incentives for development which would stimulate beneficial change in settlement patterns.

Environmentally and Economically Sustainable Countryside

A vital countryside and disposition of land uses which favour less travel require some development, perhaps even in areas previously considered to be sacrosanct, such as Areas of Outstanding Natural Beauty. But the definition of this development must be careful so as to allow only genuinely appropriate uses. Conditions on planning permissions to allow only agricultural workers to occupy housing have been widely abused, but 'low cost' housing permitted where ordinary housing would not have been, seems to have worked. There is a place for experimental housing and other buildings, made from renewable resources, especially (otherwise) low-value, small-dimension, coppiced timber. There is an example of such development in East Sussex where, eventually, despite the current local planning policies, a house was built which enables a family to live 'on-site' and look after a woodland and its visitors. The experimental industrial buildings in Beaminster, Dorset, made from coppiced wood, are also worthy exceptions to a 'no development' approach.

Source of Renewable Resources

More generally, the countryside is the source of renewable material which will become our main resources as we progress through the next century and we should start planning now for the transition from imported, non-renewable materials to local, renewables. Again this will require great vision and the sacrifice of some existing policies to enable us to play our responsible part in such issues as reducing fossil fuel use and increasing the proportion of electricity generated from renewable sources. In assessing the likely magnitude of developments the White Paper should have regard to scenarios for energy consumption, efficiency and fuel mix. The paper should also stress the importance of incentives for investment in energy efficiency in order to reduce the total demand for alternative forms of energy capacity which carry high economic and environmental costs.

Public Transport

The White Paper should promote investigation of ways of making rural mobility more efficient and innovation to the same end. National measures to improve the efficiency of vehicles will make a contribution in rural areas but specific initiatives will also be necessary, especially to improve vehicle occupancy rates. Improvements in public transport are unlikely to bring substantial benefits unless steps are taken to make it more attractive to potential users. Reliability is a key issue and it will be important to make it simpler for the occasional user to find out when a service will be provided. That said there is a need for a proper examination of users and potential users to investigate what exactly is the barrier that they have to using public transport.

Patterns of transport demand in rural areas tend to be uneven so that measures to

stimulate organised private transport should be developed in parallel with public initiatives. Developments in information technology will make it easier to match supply and demand but security issues should not be underestimated.

Environmental Impact of Agriculture

The need to attain sustainable patterns of economic development whilst minimising adverse effects on the quality of life means that all influences on the environment should be considered on an equivalent basis when devising development strategies. It follows that the cost effectiveness of reducing, for example, nitrogen and methane emissions from agriculture should be evaluated on the same basis as those from transport, industry and the domestic sector when formulating national strategies for attainment of greenhouse gas and critical load commitments. The White Paper should discuss fully the problems of such an approach and make proposals as to how they might be overcome.

NEIGHBOUR NOISE CONTROLS

NSCA has welcomed the recent Department of Environment consultation paper on noise controls (see Update section of this issue of *Clean Air*), but warned that new legal powers would not be enough to tackle the boom in neighbour noise problems.

Many of the proposals are in line with our recommendations to the Working Party on Neighbourhood Noise (see *Clean Air*, Winter 1994) — streamlining of existing procedures, co-operation between the police and local authorities, and clarification of confiscation powers are all important.

More controversial is the proposal to give LAs the powers to act immediately and impose spot fines, based on measuring noise levels. This would align with practice in some other countries, which tend to rely on objective tests. However without police support it could place local authority EHOs in dangerous positions. They already have the power to serve abatement notices and confiscate equipment, but need police support to do this. So although this might be a useful power in theory, in practice LAs may prefer to stick to current arrangements unless they have improved police co-operation.

Discussions about new legislation should not divert attention from the fact that noise enforcement is a resource-intensive activity, whether for LAs or the police. Any legislation requires political commitment at both local and national level to provide the necessary resources for noise control.

Some crucial elements of noise policy remain to be tackled. Perhaps half of all neighbour noise problems can be attributed at least in part to inadequate sound insulation levels. It is scandalous that inadequate enforcement of Building Regulations is resulting in a national housing stock which fails to protect residents from normal levels of neighbour noise. There is also a need to address attitudes towards noise. At a time of changing social norms, we should seek to establish what is and is not acceptable neighbourly behaviour.

"GREEN" PETROL: DANGER OF CONFUSING CONSUMERS

NSCA warned that the launch by Tesco of low-benzene petrol in March would confuse and could mislead consumers.

NSCA pointed out that whilst benzene is an air quality concern, the actual level of benzene in petrol bears little relationship to benzene tailpipe emissions — the overall formulation of petrol is what is important. There is a danger that by reducing one component, pollution will be caused by an increase in another.

NSCA has always been totally against the marketing of any car fuel as environmentally friendly — there is no such thing. The differences between brands of petrol and diesel are marginal and the significant factor is the state of tune of the vehicle. NSCA suggested that petrol retailers who really want to cut air pollution should install free emissions testing equipment at their petrol stations.

In a press statement, NSCA reiterated its message to motorists: buy the most fuel-efficient car possible, keep it well maintained, and use it as little as possible. You certainly can't salve your conscience by buying petrol which makes claims about the environmental impact of just one of its ingredients.

NSCA NEWS

DIVISIONAL NEWS

East Midlands and Eastern Divisions

Since the last issue of *Clean Air*, there has been one Divisional Council meeting and an open meeting at the Toyota Motor Manufacturing (UK) plant at Burnaston near Derby.

The Divisional Council (held on 23 February) considered a report of an environmental conference held on 4-5 December 1994 that had been organised by Ken Coates, MEP for Nottingham North and Chesterfield. Although the programme covered various pollution problems in North Eastern Derbyshire — e.g. the M1 widening, pollution of water and gas from abandoned coal mines, and emissions of dioxins — it was felt that the discussions had been "pressure group led" and politically motivated; the Division would therefore await developments before deciding on any further involvement.

Ketton Parish Council had been in touch with the Division to express concern about the burning of "Cemfuel" (a mixture of solvents and hazardous waste) by Castle Cement Ltd. The Division had reported the PC's concerns to the Society's Technical Committee who, following discussion, had considered that:

> "[the] use of "Cemfuel" in cement kilns is acceptable and, indeed, may on occasion be desirable for reasons of energy efficiency, providing that fuel composition, operating conditions and emission limits are specified and monitored in relation to the environmental risks. Fuel specifications should be set with precaution, and in this connection, halogen contents of more than one per cent should be justified on the basis of a conservative analysis of the environmental impact.
>
> It was however considered that to provide a foundation for public confidence in "Cemfuel" utilisation, HMIP should clarify their guidance on stack and environmental monitoring protocols as a matter of urgency".

Local authorities in the area had held a coordinated "Dirty Diesel Detection Day" on 1 February in support of NSCA's campaign to cut vehicle pollution from diesels and for better enforcement of vehicle pollution controls. The results would be analysed and sent to NSCA in Brighton for incorporation into the returns from other areas and local authorities.

Dr. Mary Newlands of the South Derbyshire Health Authority briefly explained a base line study that was being carried out in Derby City concerning asthma and air quality. The study would be centred on deprived schools and would utilise GPs' "chronic management register". Monitoring in the first instance would be carried out at individual schools using the City Council's mobile monitoring facility and diffusion tubes, although it was felt that the latter would not identify peak concentrations of air pollutants.

Seventy-one members and guests of South Derbyshire District Council attended a very enjoyable and informative open meeting at the Toyota Motor Manufacturing (UK) Plant, Burnaston, Derby on 16 March — the day that Toyota announced the creation of 1,000 additional jobs at the plant. After a welcome by Cllr. Peter Coxon (Chairman, South Derbyshire DC), an introductory video, John Birkett (Deputy Director of Planning and Economic Development, South Derbyshire DC) gave a technical presentation on planning considerations in relation to the location of the Toyota Plant at Burnaston.

Akim Kreuser of Toyota then explained how Toyota had addressed and implemented the requirements of the *Environmental Protection Act 1990*, focussing in particular on the paint application in the vehicle manufacturing process. The site includes both HMIP and local authority controlled processes. There had been no justifiable emission or nuisance complaints with regard to the Plant, which taking into account its magnitude was some achievement.

A train tour of the Assembly Plant followed a buffet lunch and the meeting ended with a vote of thanks from the Chairman to all speakers, to Toyota Manufacturing (UK) Ltd and to South Derbyshire DC for hosting an interesting and educational visit.

Open Divisional events for the remainder of 1995 include:

- 29 June (following the AGM), visit to European Gas Turbines, Lincoln.
- 27 September, visit to the Sizewell "B" power station. (Note: the Society is to review its fuel and energy policy, and in particular its views on nuclear power).
- 29 November, visit to Butterly Brick Company and Newark & Sherwood DC.

North West Division

Partnership is a focal point in NSCA policy for the 1990s and beyond; and thus it was that in partnership with March Consultants, Knowsley MBC, the Government Office in Merseyside and the NRA that the Division ran a seminar on 8 February on waste minimisation.

At a token fee of £10 which covered lunch and room hire, the day represented good value for money, particularly since the focus of the seminar was on training; the programme covered awareness, case studies and a workshop with the day being completed by a final round-up which delegates found extremely useful and instructive as it provided an opportunity for interchange of ideas and possibilities.

Waste minimisation was portrayed as affecting all businesses, whether large or small, public or private sector, administration or manufacturing; it was described as being the building block for sustainability since through it many pollutants can be reduced or, better still, removed from the waste chain.

Given the topicality and central importance of the subject and an excellent platform, it was disappointing that only 16 delegates attended. The meeting was well publicised by the organisers so that Society members and others would have been aware of it well in advance. So why did we not see more people on the day? Local authortiy members and officers with an interest in environmental health still dominate our membership and for them waste minimisation is not on the "must do" list – although they would all recognise its great relevance to their work. For business waste minimisation is usually near the top of the "must do" list for those who wish to remain competitive. Perhaps they do not know us or do not trust us; more probably, like their counterparts in LAs, thay are too stretched coping with today to think about tomorrow. Either way there is a great challenge to NSCA as a promoter of sustainability.

To end on a more encouraging note, quality and not quantity breeds success and this was certainly the case; delegates left the seminar secure in the knowledge that they could reduce their costs and identify with the initiatives slogan of "waste minimisation pays".

South East Division

The South East Institute of Public Health (SEIPH) in conjunction with the South East Division of the Society, held a one day Seminar on Planning for Air Quality at Guys Hospital in London on 27 January. This brought together planners and those concerned with air quality to look positively at the issues surrounding air quality and planning, and to identify the current options for policy change.

Over 70 delegates attended the seminar which was chaired by Chris Williams, President of the County Planners Officers Society. The key speaker was David Lewis, Secretary to the Royal Commission on Environmental Pollution, who outlined the options available to planners and those involved in air quality. The morning session was devoted to a series of lectures on air quality monitoring progress and future developments, Planning Policy Guidance and progress, and future transport policies. The afternoon session was devoted to three workshops which afforded delegates a

chance to discuss relevant individual problems. John Rice, Director of SEIPH, and Simon Hickmott, Senior Planner for East Sussex County Council, both members of the South East Divisional Council participated in the workshops on Air Quality Management Toolkit and Informing and Listening to the Public respectively. Tom Crossett, NSCA Secretary General, summed up the day's proceedings which were very successful and highlighted the need for proper planning to make air quality management effective.

The 40th AGM of the Division will be held on Tuesday, 23 May 1995 at 2 p.m. in the British Coal Corporation Building, Grosvenor Place, London SW1. All Members of the SE Division are cordially invited to attend. After the AGM in order to update members on the very important topic of water resources and pollution Mr L.D. Jones, Regional Manager of the National Rivers Authority — Thames Region will address the meeting on the Protection of Groundwater, the workings of the NRA with some comments on the new Environment Agency.

West Midlands Division

The seven West Midland Metropolitan District Councils, Birmingham, Coventry, Dudley, Sandwell, Solihull, Walsall and Wolverhampton took part in a co-ordinated "Dirty Diesel Detection Day" exercise in the week commencing 3 April. The results will be sent to NSCA in Brighton for incorporation into the results from all the surveys which have been carried out in other parts of the UK.

The Hon. Secretary was invited to speak on the *Environmental Protection Act* and the work of the Society on 24 March at the inaugural meeting of a new "Environment Club" set up for The Rubber Industry by RAPRA Technology Ltd, Shawbury, Shrewsbury SY4 4NR.

NSCA POLICY DOCUMENTS AND REPLIES TO CONSULTATION DOCUMENTS October 1994-March 1995

Please contact Sally May at NSCA, 136 North Street, Brighton BN1 1RG (Fax: 01273 735802) if you would like a copy of any particular document not published in *Clean Air*. The date following each entry is the date of the NSCA document/letter.

DOE Amendments to Environmental Protection (Applications, Appeals & Registers) Regulations 1991. 7 October.

House of Commons Environment Committee Inquiry into Volatile Organic Compounds. 17 October. (*Clean Air*, Vol. 24, No. 4).

NSCA Survey on the Implementation of Noise Nuisance Legislation. 21 October. (Summary in *Clean Air*, Vol 24, No. 4).

NSCA Local Authority Guidelines on Noise Problems. 26 October. (inc. in 1995 NSCA annual conference papers).

Options for the Geographical & Managerial Structure of the Proposed Environment Agency: DOE-commissioned report. 31 October. (Summary in *Clean Air*, Vol. 24, No. 4).

Instrumented Smoke Emission Test for London Taxis (DoT). 4 November.

UK Round Table on Sustainable Development (DOE). 9 November.

Proposed Environment Agencies Bill – Lords Briefing. 15 November.

European Environment Agency – House of Lords EC Committee (Sub-Committee C). 24 November.

Review of Noise Legislation: 1994 Working Party (DOE). 24 November. (*Clean Air*. Vol. 24, No. 4).

Environmental Accreditation Criteria (National Accreditation Council for Certification Bodies). 1 December.

1995

Rural White Paper – DOE/MAFF. 20 January. (This issue of *Clean Air*).

The Environment Bill: Lords Committee Stage – NSCA Strategy. 25 January.

Reciprocal Exchange of Information and Data on Ambient Air Quality (COM(94) 345 def. (EC) – Briefing prepared for Anita Pollock MEP. 30 January.

Quality of Countryside: Quality of Life, The Countryside Commission. 27 February.

Local Air Quality Management – NSCA Policy endorsed by Council at Meeting of 9 March.

REPORTS

USE OF AIR QUALITY STANDARDS AND LOCAL AIR QUALITY MANAGEMENT IN THE EUROPEAN UNION AND OTHER COUNTRIES

Paper for the UK Department of the Environment Conference, Air Quality: Meeting the Challenge, 23 February 1995

Greg Archer
Monitoring and Assessment Research Centre
King's College, London

Introduction

On 19 January 1995, John Gummer, the Secretary of State for the Environment, announced publication of *Air Quality Meeting the Challenge*,[1] which laid out the government's strategic policies for air quality management. These policies are based upon an entirely new framework of air quality standards and targets, underpinned by provisions for local assessment and management of air quality.

The application of a more central role for air quality standards is now being developed by the European Union and many countries. This paper is intended to highlight the frameworks, and provide examples of the approaches, used to manage air pollution throughout the world, with particular emphasis upon the use of air quality standards and local air quality management. The paper therefore presents the UK government's recent proposals in a global context and enables comparison of the proposed UK approaches with those countries possessing the most advanced air quality management strategies and rigorous environmental protection policies.

Air Quality Management in the European Union

The development of a new approach to air quality management in the UK is being mirrored in a number of other nations and by the European Union (EU). Traditionally European legislation on air quality has followed the parallel application of emission and product standards (such as those for motor vehicle exhaust emissions and maximum permissible gasoline lead concentrations); and air quality standards (which prescribe minimum acceptable ambient air quality with the EU).[2] The most recent development of European policy is the *Proposal for a Council Directive on Ambient Air Quality Assessment and Management*[3] which is currently before the European Parliament. This framework Directive has as its general aims to:

- establish objectives for ambient air quality in the European Community designed to limit or prevent harmful effects to the environment as a whole and to human health;
- assess the ambient air quality of Member States in a uniform manner;
- make available to the public information on ambient air quality;
- maintain good ambient air quality and improve poor ambient air quality.

The Directive proposes establishing *Alert, Long-term Limit Values and Current Permitted Values* for 14 different pollutants. The Alert threshold would signify a level above which the public should be informed of an air pollution episode. The Long-term Limit Value would represent the level of acceptable air quality to be achieved in 10 to 15 years; and Current Permitted Value would be progressively reduced throughout the transition period until the Long-term Limit Value is achieved. If approved, Member States would classify areas according to levels of pollution within them:

1. **where air quality exceeds the Current Permitted Value** – measures and programmes must be initiated in order to achieve the Current Permitted Value as soon as possible and achieve the Long-term Limit Value in the time limit specified (an area of poor air quality);
2. **where air quality is above the Long-term Limit Value but below the Current Permitted Value** – no increase in pollution levels is permitted and the Long-term Limit Value must be achieved in the time limit specified (an area of improving air quality);
3. **where air quality is below the Long-term Limit Value** – no action is required (an area of good air quality).

The proposed Directive therefore recognises the need for local air quality management to address areas with poor air quality and uses air quality standards to define these areas. The aims and basis for the new proposals for air quality management within the UK and EU are therefore very similar, with UK and EU policies broadly developing in a parallel. Other Member States of the EU in their current national legislation however put different degrees of emphasis upon air quality standards, emissions controls and the degree to which sub-national levels of government can influence management approaches.

The Netherlands currently has the most developed air quality management strategies of the Member States of the EU, operating a balanced effects-oriented approach, with well established emissions controls. The basis of the Dutch system is the establishment of air quality standards based on a framework of risk management.[4] Air quality *Limit Values* have been established at below the no adverse affect level for non-carcinogens and below 10^{-6} deaths per annum for carcinogens. The *Limit Value* is **not** to be exceeded. A *Guide Value* has also been established – lower than the *Limit Value* – as a realistic long-term air quality objective (but one which if already attained should be maintained). The levels of pollution adjacent to busy roads currently exceed *Limit Values* and for these areas the standard is being progressively reduced until the year 2000 when no further violations will be permitted.

National, Provincial and Municipal levels of government in The Netherlands are jointly responsible for managing air quality. National government policy has been

particularly aimed at progressively reducing emissions from motor vehicles through the use of fiscal measures. The cost of using a vehicle has been significantly increased (by raising duty on gasoline), whilst the cost of vehicle ownership has been reduced (by lowering road tax). There are also a number of approaches being implemented to encourage use of public and clean forms of transport. The Dutch Provinces are broadly responsible for managing emissions from large stationary sources[5] through the application of national emissions limits based upon those used in Germany.[6] There is, however, increasing flexibility in the control of emissions from industrial sources, as is shown in the box below.

Emission Controls by Industry in the Rijnmond Area

The Rijnmond area lies in the west of The Netherlands and is a major industrial area and designated sanitation area. In 1985, to improve air quality and attain the Dutch Limit Values, Provincial regulators authorised reduced permitted total emissions for the sanitation area. Rather than issuing individual licences requiring new pollution control equipment, the polluting companies were requested to develop a combined emission control plan to meet the reduced emissions targets under the chairmanship of the local port authority. The development of the plan took considerably longer than anticipated, but the required outcome was successful and a number of additional benefits have accrued including:[7]

- for the authorities, considerable time was saved in avoiding the development of detailed plans;
- companies were able to incorporate emission abatement measures into their regular investment programme and individual circumstances were more comprehensively included in the emission control plans.
- there are no appeals;
- there was improved relations between regulator and licensee.

Clearly this type of approach is only appropriate in predominantly industrial areas with a co-ordinating authority to oversee the development of the plan. Furthermore, public consultation concerning the required emission targets must be conducted if confidence in the proposals is to be obtained. Although it is likely schemes of this type will only be successful in specific circumstances, when applicable they clearly offer considerable potential benefits for polluter and regulator.

In The Netherlands municipalities larger than 40,000 inhabitants are charged with maintaining acceptable air quality in urban areas where emissions are dominated by road transport.[8] These municipalities are required to ensure all areas within their jurisdiction attain *Limit Values.* Roadside concentrations must therefore be determined and this can be achieved either through ambient monitoring, or use of the CAR-model (**C**alculation of **A**ir Pollution from **R**oad Transport[9]) which estimates air quality based on traffic data. The model and measurements are now being applied to produce city environmental traffic maps for CO, NO_2 and noise nuisance supported by government funding. These models are then used to develop traffic management schemes to ensure the *Limit Values* are not violated. A variety of schemes have been introduced by municipalities to reduce traffic and a brochure to assist with traffic management has been produced by government.[10] Grants are available to municipalities to support infrastructure developments needed to improve air quality. Although municipal authorities therefore have considerable responsibility to manage local air quality and meet air quality objectives, it is clear they are also provided with substantial support from central government to assist them with this task.

A number of other Member States of the EU are also adopting air quality objectives as their principal air quality management tool. These include Ireland, which after exceeding the EU Directives for black smoke in Dublin introduced pollution controls developed using a model to assess the impact of different emission abatement options. Italy, Spain and Portugal similarly use ambient air quality oriented policies as the basis for air pollution management, although plans are currently at an early stage of development.[3] The new Member States of the EU have a tradition of environmental protection. Sweden has historically adopted emissions limits based upon the principle of Best Available Technology and Environmental Good Practice, supported by a comprehensive system of emission controls.[11] Recently, however, new target values for urban air quality have been established (which are significantly lower than WHO European Guidelines[12]) to be achieved by the year 2000. Finland has similarly developed a balanced approach to air pollution control, but with a strong emphasis on economic instruments, voluntary schemes, land-use planning and ecological protection of the forests.[13] In Austria there are air quality objectives for protection of forests and health during air pollution episodes which are specifically linked to emission regulations; although in general permissible emissions are not directly based upon local air quality.[11]

The Federal Republic of Germany operates a system predominantly based upon emissions controls. The basic law for air pollution control (The Federal Immission* Control Act) does, however, incorporate both facility related emission controls and area related measures such as clean air plans, smog ordinances and immissions measurements. Emissions controls are laid down in the *Technical Instruction on Air Pollution Control*[6] (TA Luft) which are uniformly enforced by the 16 Länder (States) – although the 5 Länder incorporating the former East Germany currently have exemptions concerning emissions controls for existing plant.[14] The Länder are also responsible for measuring immissions and establishing "pollution zones" in areas of poor air quality. Within these zones the Länder must conduct a detailed analysis of the air quality problems, as is explained in the box below.

The systems of air quality control in France[16] and Belgium[11] are broadly similar to that in Germany with a strong emphasis on national emissions standards. In areas of France where EU limit values are approached *Special Protection Zones* – of which there are currently 6 – have been established and special provisions upon fuel quality and other emissions control are enforced.

Within the countries of the European Union there is clearly a wide disparity with regard to the extent of national air pollution policy and the relative use of emission/product standards and ambient air quality objectives for pollution control. In general, historically, the emphasis has been upon emission controls. There is now, however, increasing application of the use of air quality standards and local air quality management, particularly in areas which exceed or approach EU Limit or Guide

*Immission (pronounced "eyemissions"), is legally defined as "air pollutants, noise, vibration, light, heat, radiation and associated environmental factors affecting human beings, animals, plants or other objects." There is no equivalent English term although "harmful air pollutants," covers most of the definition. Emissions are defined as "air pollutants, noise, vibration, light, heat, radiation and associated phenomenon originating from an installation."

Air Quality Control in North Rhine-Westphalia

North Rhine-Westphalia (NRW) is the most heavily industrialised and populated German Länder and includes the Ruhr Region — the single largest industrial area in Europe. To maintain acceptable air quality the NRW authorities have implemented a clean air plan based upon 7 components:[15]

1. **identification of hot-spots** — areas characterised by particularly high levels of pollution;
2. **emissions file** — an inventory of the nature and quantity of emissions from all sources including their timing, distribution and conditions under which they occur;
3. **immissions file** — of air quality from a network of 76 automatic monitoring stations arranged in an 8km square grid in densely populated areas including instruments to measure SO_2, PM_{10}, CO, NO_x, O_3 and meteorological variables;
4. **effects file** — maintaining a record of studies on the effects of air pollution for human health and the natural and built environment;
5. **cause analyses** — highlighting the relationship between sources, emissions and immissions in order that the legally stipulated polluter-pays principle can be efficiently utilised;
6. **forecast of emission and immission development** — in particular for industrial, housing and road developments.
7. **plan of action** — derived from each of the above, concerned primarily with preventative **not** counter-measures.

Values. Although most emission, product and air quality standards are still set by national (Federal) government, the implementation and enforcement of policies and responsibility for maintaining or attaining acceptable air quality is increasingly resting with sub-national levels of governments at a state/provincial or local authority/municipality level. In a number of Member States very little national legislation has been passed in addition to that required to implement EU Directives. Furthermore, EU Directives are not implemented in all countries with the same comprehensiveness. The wide divergence in both the nature and extent of air quality management policies within the single market is a primary reason for the introduction of the *Proposal for a Council Directive on Ambient Air Quality Assessment and Management.*[3]

Local Air Quality Management in Countries Outside of the EU

Outside of Europe countries with well developed air pollution control policies predominantly use local management based upon attainment of air quality standards, the best example of which is provided by the USA. US legislation is based on the Clean Air Act of 1970 which was substantially amended in 1990 in recognition that the NAAQS were not being attained.[17] Under this legislation each State must implement its own air quality management programme to attain the National Ambient Air Quality Standards (NAAQS). In areas in which NAAQS are currently met the requirements upon the State are to maintain, or prevent significant deterioration, in air quality. In non-attainment areas, a programme must be established by the State to achieve NAAQS within a specific time frame, the length of which is dependant upon the severity of the current exceedence. An example of how the non-attainment areas are classified is shown below for ozone.

The USEPA may grant an extension of up to one year for ozone attainment ($<$120 ppb) but does not in general specify how the attainment is to be achieved, which is the responsibility of the *State Implementation Plan.* Some product standards, vehicle emission regulations and required emission reductions are however specified at

Ozone Non-attainment Classifications, Levels and Attainment Dates[17]

Class	*Level (ppb)*	*Attainment Date*
Marginal	121 - 137	1993
Moderate	138 - 159	1996
Serious	160 - 179	1999
Severe 1	180 - 190	2005
Severe 2	191 - 279	2007
Extreme	>280	2010

The levels represent the fourth highest hourly value in the preceding three year period.

a Federal level. Attainment plans for CO and PM_{10} are also required. For areas classified with air quality *serious* or poorer milestones have been established which the non-attainment areas must achieve if additional emission controls are not to be imposed.

To address the issues of transboundary pollution the *State Implementation Plans* are required to consider the impact of emissions from within their jurisdiction upon other areas. The classification of an area has profound effects on emissions control introduced by States upon both industrial and mobile sources — the most stringent requirements being introduced in Southern California — the only area with an *extreme* air pollution classification. In California new legislation requires that by 1998, 2%, of cars on sale must be zero-emission rated (electric).

Vehicle Emission Controls in California

In California State regulations to improve air quality require that by 1998, 2% of cars on sale must be electric and that by 2003 this proportion must be 10%. Car manufacturers could be fined $5,000 for each car they fail to sell short of the quota and ultimately could lose the right to sell cars within the State. Under the threat of such stringent penalties the American motor industry and others are now seriously considering how to promote sales of electric vehicles. A General Motors survey found 84% of households drive less than 120km per day[18] — well within the range of electric cars — As many of these families possess two or more vehicles there is potential for one of these to be electric. Special driving lanes and parking spaces are proposed to encourage electric vehicle use and a 10% federal tax exemption is now offered to reduce the price of electric vehicles. The state regulated power companies are enthusiastic to develop recharging stations and a feebate scheme has been proposed to tax gasoline cars by $2,500 and provide $440 to owners of electric vehicles. In California, legislation will therefore ensure the penetration of electric vehicles into the car fleet, but will be strongly supported by incentives to switch from gasoline.

Other strategies to reduce emissions from motor vehicles include the use of reformulated gasoline with reduced O_3 generating capacity; and trip reduction programmes which must be implemented by employers with greater than 100 employees.[19] Light rail schemes are also being developed in business centres. A wide variety of approaches are therefore being adopted to address California's air quality problems.

US environmental legislation such as to establish or revise NAAQS is a lengthy process due to the open decision making process in which all interested parties participate. This process strongly contrasts with most other countries, such as

Germany, in which discussions and decisions predominantly take place in private with invited representatives from industry and trade associations before a decision is taken. The American system has the disadvantage that it is slow, but generally does produce greater consensus and input from a wider group of bodies is obtained. In the UK air quality standards are based upon the work of the Expert Panel on Air Quality Standards, a government appointed independent expert committee which reviews the available information and makes recommendations to the Secretary of State for the Environment.

As in the USA, Japanese air quality management is also based upon achieving ambient air quality targets. These objectives are not, however, legally enforceable and emission/product standards are therefore also extensively applied.[20] In the larger agglomerations and industrial centres detailed emissions inventories and substantial monitoring are combined in state-of-the-art models to assist in the production of detailed emission reduction plans.[21] There are, however, substantial regional variations in the extent to which management strategies have been developed and implemented throughout Japan.[3] One unique aspect of Japanese air quality management strategy is the Pollution-Related Health Damage Compensation Law which provides an administrative (non-judicial) system for compensating victims of pollution by the polluter.[20] The link between the polluter and victim is so difficult to prove the legislation only requires the victim to show there is a probability of injury based upon the levels of pollution and known health effects. The details are complex, but the initiative is well received within Japan and the establishment of a grievance committee has helped to alleviate some of the concerns of industry.

In Australia – as in the USA – the States are the principal authority issuing environmental legislation; State authority has superseded that of the Federal government with the exception of emissions limits upon vehicles (which are enforced at a State level) and matters relating to international agreements such as those concerned with global warming or stratospheric ozone depletion. With such a high level of State autonomy quite different air quality management frameworks existed within the country. However, in 1992, the Inter-Governmental Agreement on the Environment was signed by Federal, State and Local Government endorsing a national framework based on ambient air quality objectives, the national Environmental Protection Measures (NEPM).[22] The means by which attainment of the air quality standards is achieved is a State responsibility (although a range of options to assist with compliance is included in the NEPM document). Three categories of air quality indicators have been developed:[23]

1 general indicators for 6 criteria pollutants (SO_2, NO_2, O_3, Pb, CO and particulate matter);
2 source specific indicators (currently set for SO_2 and fluoride);
3 indicators for the protection of sensitive ecosystems (currently fluoride only).

Victoria and Queensland have now established State air quality management programmes based upon the NEPM and Western Australia has plans for specific regions. Variations in approaches between States are clear, but both are now managing air quality locally within the national framework.

Some of the world's most rigorous pollution controls exist in the highly industrialised economies of South-East Asia such as Singapore[24], Taiwan[5] and Hong Kong[25] which base their air pollution control framework upon attaining US NAAQS and use the US Air Pollution Index (API) supported by strict emission and product standards. An example of the approach adopted in Singapore is shown in the box below.

Air Pollution Control In Singapore

In Singapore ambient air quality should not exceed half the US NAAQS except under exceptional circumstances (such as the forest fires which recently raged in Malaysia significantly elevating particulate matter concentrations in Singapore). To achieve these strict air quality standards rigorous emission controls are imposed and enforced upon industry and vehicles.

Industry is required to use best practical means of production and fuel quality standards are strict. All new vehicles in Singapore are required to have three-way catalytic converters, but additional laws also restrict vehicle ownership and use – particularly for commuting. The Area Licensing Scheme was introduced in 1974[24] and requires all vehicles entering the city centre during the morning peak periods to obtain a licence. The scheme has been revised on a number of occasions and now is operated electronically and acts as a powerful financial disincentive for driving to work – particularly in company cars which are charged at a higher rate. To maintain ease of movement there has been a huge investment in public transport including a new fully automated mass-rapid-transport system into which are being integrated cycle paths. Park and ride schemes and a comfortable, regular, reliable bus service ensure those commuters who do not drive are not disadvantaged. Parking prices are also regulated to encourage short stay shopping but penalise all day commuting and ensure there is no blight affecting city shops.

Singapore also discourages vehicle ownership through punitive import, registration and road taxes – although reductions can be obtained for *Weekend Cars* (distinguished by their number plate) which cannot be driven on weekdays without a special licence. Financial incentives also exist to scrap old cars and additional road taxes are imposed for owners of older, more polluting, vehicles to increase the rate of penetration of cleaner cars into the vehicle fleet. A quota system also limits the number of new registrations allowed each month the rights to which are auctioned. The Government has also made a commitment to develop the infrastructure required to promote use of electric vehicles when these become viable.[27] Although some of the policies introduced in Singapore to limit vehicle emissions would not be appropriate in most other countries, some of the approaches could be adapted or adopted in many countries with urban traffic congestion to alleviate the effects.

Use of Standards and Local Air Quality Management During Pollution Episodes

In the UK most air quality problems are short-lived episodes of pollution caused by poor natural pollution dispersion due to the weather conditions. Reducing the health effects of these episodes, such as occurred in London in December 1991, is one aspect of air pollution control particularly well suited to the use of air quality standards or guidelines and local management. Most developed countries are now using automatic monitoring equipment able to provide hourly information on levels of pollution and which can therefore be used to constantly assess the air quality. In many countries, including the UK, it is also possible to predict air pollution levels in the same way as weather forecasting, to give advanced warning of air pollution episodes. The use of air quality guidelines which trigger responses to air pollution episodes are already a component of EU legislation in the Ozone Directive.[26] This requires public information and warnings to be issued if concentrations become significantly elevated and the same approach can clearly be used for other types of pollution episodes. The concentrations at which public information and warning levels are established are

significantly higher values than those for air quality standards, the principles are however very similar. The UK Department of the Environment is bringing forward plans concerning alleviating air pollution episodes later this year and it is therefore of interest to examine mechanisms which operate in other countries.

A number of countries go further than issuing warnings to the public during pollution episodes and also reduce emissions to alleviate the effects – as do some large industrial plants in the UK. In the USA – where episodes of pollution in some areas are significantly worse than those experienced in the UK – the Pollution Standards Index (PSI) is a well established technique for informing the public of the levels of air pollution. The PSI converts the concentrations of each pollutant to a scale of between 0 and 500. As the PSI increases short-term emission controls are imposed upon a variety of sources in the affected area and public warnings and advice issued.[19] France has established Alarm Zones[5] in areas which are known to experience episodes of poor air quality. In the event of a pollution episode being forecast major fuel consumers are required to switch to low sulphur fuels and some industrial operations are affected. Photochemical smog episodes have been shown to lead to an increase in respiratory and cardiovascular mortality in Paris resulting in calls for controls on motor vehicles during episodes. Legislation in France does exist to enable this, however, the French government has no plans for this to be implemented and the Environment Minister recently stated only future urban planning projects "could reduce the role of the car in cities."[28] In Greece air quality management strategies are not well developed nationally, but well advanced in Athens (which experiences extremely severe photochemical pollution episodes in summer). Additional air quality guidelines – significantly higher than Greek air quality standards – are used to trigger different responses and emission controls, including stringent restrictions on vehicle use and industrial emissions in the city during episodes. Mexico City, which experiences some of the world's worst photochemical pollution, adopts a similar approach.[29] Smog alerts are also well developed in Austria,[11] where the Smog Alert Act has been in force since 1989. This has three guideline levels: prealert, alert 1 and alert 2 for SO_2, SO_2, + particulate matter, CO and O_3. Additional emission controls are progressively introduced as these alert levels are exceeded. Germany also operates a similar system[5] but is also carrying out research to identify the impact of traffic control during episodes, as described in the box below.

German Vehicle Restrictions During Pollution Episodes

During four days in June 1994 the town of Heilbronn/Neckarsulm, north of Stuttgart, was closed to all vehicles except those fitted with three-way catalytic converters and the lowest emission diesel engines in an experiment to measure the impact upon air quality.[30] The result was a 40% reduction in road traffic and 50% increase in public transport use resulting in a 40% drop of NO_x concentrations from 200 to 120$\mu g\ m^{-3}$ and halving of benzene concentrations from 4 to 2$\mu g\ m^{-3}$

Conclusions

It is clear from this brief overview of air quality management approaches adopted globally that there is a wide range of frameworks utilised to control air pollution throughout the world. There are, however, a number of common themes in the

approaches adopted by countries with the most developed strategies which are therefore of considerable relevance to the authorities in the UK charged with maintaining acceptable air quality and in the development and implementation of the new policy. The use of ambient air quality standards is increasingly being introduced in nations throughout the world as a means to assess levels of pollution, prioritise needs and target resources. Air quality standards are being used to assess the nature of the local emission controls required in an area in order to ensure acceptable air quality is maintained. The EU in its *Proposal for a Council Directive on Ambient Air Quality Assessment and Management*[3] advocates this approach; and the UK Government in *Air Quality: Meeting the Challange*[1] has provided details of the strategic framework it intends to pursue to manage air quality which is also based upon this approach. The parallel paths currently being produced in the EU and UK concerning air pollution control should therefore help to ensure the final Parliamentary Bill and EU Directive adopted will be consistent and supporting.

Evidence from all countries shows that attaining acceptable air quality is a slow process. The EU in their Framework Directive[6] envisage a 10 to 15 year timeframe; and in California, (which has considerably worse air quality than in general within the EU), a 20 year programme is being implemented. Attainment of acceptable air quality will therefore be a gradual process. However, the use of intermediate targets (such as the proposed *Current Permitted Values*[3] from the EU) does help to ensure progress is maintained at the required pace and the ultimate air quality objective achieved. A policy based upon air quality standards is considerably more flexible than one based upon emission and product standards alone and enables local policies to be implemented to address local problems in a more effective manner. The policy also enables much more effective prioritisation of need and targeting of resources towards those pollutants and locations which require immediate attention based upon the risk to human health and cost to the environment of the air pollution. In order for decision makers at a local level to formulate, implement and enforce the most rational, cost-effective emission reduction strategies it is **essential** that they have access to adequate, appropriate, accurate information on the local air pollution problems. To obtain this information there are a number of tools which are required to ascertain the nature and severity of the air pollution, their causes and the most effective emission control solutions. These tools include:

1 **adequate local monitoring capabilities and/or, local air quality models** – to estimate the levels of pollution in the area;
2 **detailed emissions inventories** – to provide information on the levels, locations and nature of the pollution sources;
3 **air-shed models** – linking the above to enable predictions to be made of the impact of new developments upon air quality and impact of different emission controls upon the concentration of pollutants across an area;
4 **forecasts of air pollution episodes** – in order that warnings can be given to the public and possible remedial or alleviating emissions controls could be introduced to lessen the effect of the pollution;
5 **adequate emission control powers** – to be provided to local air quality managers to enable them to effectively control the principal sources of emissions in their areas

both to meet air quality standards, and to reduce the impact of pollution episodes through the introduction of short-term emission controls.

In those countries with the most successful air pollution control strategies it is clear that there is joint responsiblity and active participation amongst all levels of government to control emissions. Air pollution control strategies available to national governments (or autonomous State administrations) have the greatest impact upon overall air quality within an area. Although local pollution management is excellent in addressing local problems, these strategies must supplement national policies. The combination of national and local plans therefore provides the most equitable and cost effective means of managing air pollution. One potentially counter-productive aspect of local air pollution management is that pollution is simply removed from one locality to another rather than prevented. It is therefore crucial that local plans address both the impact of emissions within an area and upon adjacent areas. This is particularly important for emissions of volatile organic compounds which produce ozone in downwind areas and transboundary pollutants released from tall stacks. The experience of many countries also indicates mandatory air quality standards are far more effective in reducing emissions than voluntary codes — although a flexible approach should be adopted to non-attainment areas, depending upon the circumstances for their failure to achieve the standard.

The strategic policies for air quality management in the UK presented in the white paper *Air Quality: Meeting the Challenge*[1] provide the potential to ensure air quality throughout the UK is maintained at the acceptable levels mostly present; and that the frequency and severity of the occasional episodes of poor air quality which occur are reduced. This paper has clearly shown that an *effects-based approach supported by source-based controls*[31] is successfully used throughout the world to control air pollution and is being increasingly adopted in other countries and the EU. Furthermore, the use of sub-national levels of government to locally manage air quality is widespread throughout the world in all decentralised systems of government; local strategies offering substantially greater flexibility for control of air pollution in a rational, cost effective manner. For the future, care must however be taken to ensure the proposals are successfully blended with those of the EU; and that adequate time and resources are allocated to ensure an effective transition between policies. The experience of other countries nevertheless clearly demonstrates the new UK and EU proposals should provide the potential for more effective management of air pollution in the future.

References

1. Air Quality Meeting the Challenge, 1995, Department of the Environment, A4954, London
2. EU Environment Guide, 1994, The EC Committee of the American Chamber of Commerce, Brussels
3. Proposal for a Council Directive on Ambient Air Quality Assessment and Management, 1994, COM (94) 109, Official Journal of the European Union, Journal C216
4. Bennett G, 1991, Air Pollution Control in the European Community, International Environmental Law and Policy Series, Graham and Trotman, Dortrecht
5. Murley L, 1991, Clean Air Around the World: National and International Approaches to Air Pollution Control, 2nd Edition, IUAPPA, Brighton
6. Technical instruction on Air Quality Control, 1986, Federal Ministry of the Environment, Nature Conservation and Reactor Safety, Bonn

7. Burges J, Waque WPGM, 1989, An implementation plan, prepared by the industry, as a new instrument in policy towards a better air quality; case: implementation plan for the Rijnmond area, Man and his Ecosystem, Proceedings of the 8th World Clean Air Congress, 1989, Elsevier, Volume 4, Vereniging Lucht
8. Sliggers, CJ, 1989, The implementation of ambient air quality standards in the Netherlands, Man and his Ecosystem, Proceedings of the 8th World Clean Air Congress, Volume 4, Elsevier Publications, Amsterdam
9. Eerens HC, Sliggers CJ and van der Hout, KD, 1993, The CAR model: the Dutch method to determine city street air quality, Atmospheric Environment, Vol 27B, pp 389-399
10. Urban Traffic and the Environment, 1988, Ministry of Housing, Physical Planning and the Environment, 70876/2-88 (in Dutch)
11. Murley L, 1995, Personal Communication, National Society for Clean Air, Brighton
12. Air Quality Guidelines for Europe, World Health Organization Regional Office for Europe, WHO Regional Publications, European Series No. 23, Copenhagen
13. Esterland A, 1994, Modern trends in air quality management: recent developments applied in Finland, Clean Air '94, Proceedings of 12th International Conference and 6th Regional Conference of IUAPPA, 23-28 October 1994, Perth, Australia, Volume 1, pp 201-210
14. Brealey M, 1993, Environmental Liabilities and Regulations in Europe, International Business Publishing Ltd., The Hague
15. Pütz K, 1994, The system of air quality control in the Ruhr region, one of the most industrialized regions of Europe, Proceedings of the 7th IUAPPA Regional Conference on Air Pollution and Waste Issues, Volume 5, pp 103-111, Taipei
16. Hebz O, 1991, French air pollution control policy, Emerging issues in Asia, Proceedings of the 2nd IUAPPA regional conference on air pollution, 4-6 September 1991, Volume 1, pp 389-395, Seoul
17. Griffin DG, 1994, Principles of Air Quality Management, Lewis Publishers, Boca Raton
18. Mestel R, 1994, All charged up and nowhere to go, New Scientist, 3/12/94, pp 14-15
19. Grant W, 1994, Transport and air pollution in California, Environmental Health and Management, Vol 5, pp 31-34
20. Nishimura H, 1989, How to conquer air pollution: a Japanese experience, Studies in Environmental Science, 38, Elsevier, Tokyo
21. Miura T, 1994, Pollution prevention: Japanese approaches and politics, risk assessment strategies and pollution prevention, Papers from the 9th World Clean Air Congress, Volume 6, IU-28.02, Montreal
22. Kahn T, Morgan P, Phillips M, Sheldon-Collins P, Steer K, Wilson C, 1994, Towards an air national environment protection measure, Clean Air '94, Proceedings of 12th International Conference and 6th Regional Conference of IUAPPA, 23-28 October 1994, Perth, Australia, Volume 2, pp 549-556
23. A summary of air pollution prevention regulations in effect in Australia and New Zealand, 1994, Clean Air Society of Australia and New Zealand
24. Annual Report, 1991, Ministry of the Environment, Singapore
25. Lee FYP, Wong SKF, Ashcroft BC, 1994, Development of the air pollution index and forecast system (APIFS) in Hong Kong, Clean Air '94, Proceedings of 12th International Conference and 6th Regional Conference of IUAPPA, 23-28 October 1994, Perth, Australia, Volume 1, pp 363-369
26. Council Directive 92/72/EEC on air pollution by ozone, Official Journal of the European Union, L 297, 13/10/92
27. The Singapore Green Plan, 1992, Ministry of the Environment, Singapore
28. Patel T, 1994, Killer smog stalks the boulevards, New Scientist 15/10/94, pp 8
29. WHO/UNEP, 1992, Urban Air Pollution in Megacities of the World, Blackwell Press, Oxford
30. Edwards R, German banger ban cuts pollution, New Scientist, 20/8/94, pp 9
31. Improving Air Quality, 1994, Department of the Environment, 93 EP 389, London.

Acknowledgement

The author would like to thank Loveday Murley from NSCA and Matthew Leach of the DOE for their help with the production of this paper.

SUSTAINABLE DEVELOPMENT, POLLUTION REGULATION AND THE ENVIRONMENT AGENCY

Dr Andrew Farmer
English Nature

Introduction

At the Rio Summit in 1992 the UK Government adopted the concept of Sustainable Development. The UK's strategy on Sustainable Development was published in 1994 and outlines the first steps towards altering the basis of decision making over development in the UK. The UK Strategy outlines some of the major problems to be faced in achieving Sustainable Development and some of the principles that need to be adopted in order to succeed. However, it does not provide an outline of what sustainable economic activity would actually consist of.

The concept of Sustainable Development grew out of the impasse that was created by the discussion within the Green lobby in the late 1970s and early 1980s over limits to economic growth. Such growth was seen as incompatible with environmental protection. However, it was evident that existing aspirations in developed countries and new aspirations in developing countries were going to be difficult to overcome if environmental protection was to be achieved. Out of this debate grew the concept of Sustainable Development, i.e. of achieving economic development, but in a fashion that is *compatible* with *integrated* environmental protection.

Sustainable Development has been incorrectly presented as a balancing act between economic growth and environmental protection. Instead of balancing the two conflicting aims, Sustainable Development is a means of altering economic development until it is sustainable. In the Financial Memorandum of the Environment Bill (1994) it states that Sustainable Development is a means to "reconcile" the aims of economic growth and environmental protection. Reconciliation is not a trade-off, but a means of achieving compatibility.

While attempting to reconcile these two sides, it is evident that most of the accommodating has to take place on the side of economic development. There has been much redefinition of aspects of environmental protection (see below), but ulitmately the main changes are needed to the way that development occurs.

Sustainability is more than a process of improving environmental policy. It is a recognition that all sectors of the economy have a role in developing policies that ensure conservation of natural resources while ensuring improvements in the welfare of society. The new Environment Agency will have an important function in instilling this role into industry.

The Role of the Environment Agency

The Environment Agency will have to consider the role it plays in achieving Sustainable Development. While outline guidance has been issued, the details remain, at present, unclear and will await further Ministerial guidance. However, the Bill states:

> "4.1 The Ministers shall from time to time give guidance to the Agency with respect to aims and objectives which they consider it appropriate for the Agency to pursue in the performance of its functions.
> 4.2 The guidance given under subsection (1) above must include guidance with respect to the contribution which, having regard to the Agency's responsibilities and resources, the Ministers consider it appropriate for the Agency to make, by the performance of its functions, towards attaining the objective of achieving sustainable devlopment".

The Agency does not, therefore, have any overall duty with regard to the whole or part of the economy or environment with regard to Sustainable Development under the primary legislation. It is conceivable, however, that Ministerial guidance could lead to such a function within the confines of the Agency's areas of responsibility.

Other bodies with Sustainable Development Responsibilities

The only NDPB with a Sustainable Development responsibility in statute is Scottish Natural Heritage. Their remit is outlined in the first paragraph of the *Natural Heritage (Scotland) Act 1991* and is considerably stronger than that in the Environment Bill:

> 1.1 "SNH shall have regard to the desirability of securing that anything done, whether by SNH or any other person, in relation to the natural heritage of Scotland is undertaken in a manner which is sustainable."

The relationship between SEPA, which has the same Sustainable Development responsibilities in the Environment Bill as the Environment Agency, and SNH will be interesting to follow. It is conceivable, for example, that for this reason the Secretary of State for Scotland may issue different guidance to SEPA than is issued to the Environment Agency.

Critical Environmental Capital

Before structures and mechanisms are established to work towards achieving Sustainable Development, it is necessary to ask the simple question, what do we wish to sustain? Statements about environmental protection or maintaining "our childrens' inheritance" do not provide guidance for particular decisions.

Concepts have been developed (English Nature, 1994) in order to assess the difference values of environmental capital. The categories are apparent:

- "Critical": protecting "critical natural capital" absolutely (CNC)
- "Constant": maintaining "constant natural assets" (CNA)
- "Desirable": protecting other environmental attributes where possible.

In environmental terms critical natural capital (CNC) could refer to a number of attributes, e.g. an important wildlife site, a critical stock level of environmental resources (e.g. water).

For components of the environment which are not critical themselves, but form part of a wider asset, it is possible to define that the overall stock of this asset should not decline. These are constant natural assets (CNA). Thus loss of part of the asset would require replacement to ensure the overall value of the asset is maintained.

CNC are highly valued sites or stock levels either because they are essential for human health or because they are irreplaceable for all practical purposes (e.g. are of great age or are very complex). A good example is an ancient woodland, which is very old and cannot be recreated except over many human generations. CNC may also be defined on social grounds, e.g. the need for a particular green space in urban areas.

Pollution Impacts on Critical Environmental Capital

Most analysis of implementation of Sustainable Development has concerned that relating to planning decisions, e.g. whether the construction of a road over a particular stretch of land is justifiable. In these instances the issues are often more readily understood. Thus a road through a site containing ancient woodland is unsustainable as the site is completely destroyed immediately the construction takes place.

However, the impacts of pollution are rarely so obvious. The discharge of large quantities of pollutants to a river significantly reducing its biological interest may be analogous to the impacts of construction development. Most pollution, however, is more diffuse in its impacts.

For example, air pollutants emitted near an ancient woodland site may be sufficient to cause impacts on that site (e.g. sulphur dioxide or fluoride emissions). In current types of operation, however, such emissions would be very unlikely to cause widespread damage which could be readily defined as unsustainable. It is more likely that impacts would involve damage to some trees and possibly the loss or reduction of some ground flora species.

In defining CNC it was noted that the potential for replacement was an important criterion. The ancient woodland is, for all practical purposes, irreplaceable. However, this does not necessarily apply to every component of the site. Some species are difficult to establish and could be identified as CNC. For example, destruction of important lichen species may be irreplaceable because pollution results in long-term damage to bark thus making re-establishment very difficult. Other species may be replaceable. These would fall under the category of CNA. In some circumstances the loss of "replaceable" species may be unacceptable because of the need to maintain the overall character of the site. The operation of the process could, therefore, be justified in some circumstances, with the proviso that any damage to CNA is compensated for.

In many instances pollution impact is not attributable to one source. Acid deposition is a classic example. The UK strategy examines this example and equates a critical load with a level of deposition which is sustainable. Generally this is correct, although it is important to remember that critical loads have not been developed for all components of the ecosystem and thus meeting currently defined critical loads would not necessarily mean that all acid deposition is sustainable.

It is also possible that exceedence of a critical load in some instances is not unsustainable. This particularly applies to soils. Equating critical load with sustainability would suggest that all land is CNC. This is obviously not the case. Thus examination of critical load exceedence requires a study of the land use of areas at risk. In reality the most difficult areas to protect as deposition is reduced are some of the

uplands and these do contain many sites that would be defined as CNC. However, it is important to consider more fully the sustainability implications of the use of the critical loads approach.

Pollution Regulation Issues

In considering the sustainability implications of a planning application, it is possible to ask whether the impacts of the proposed development are or are not sustainable. Sometimes this is the case for polluting processes. However, more often the process is likely to contribute to a level of air pollution which may be unsustainable.

This poses a number of problems for the regulator. Some are practical measures such as who is responsible for replacement of CNA or who should pay for monitoring of impacts.

The BPEO assessment guidance issued by HMIP (HMIP, 1994) provides the basis for dealing with this issue. It allows the regulator to assess the relative impact of the emissions from a process against both environmental standards (i.e. potential for damage) and existing environmental quality. It is, therefore, possible to assess the relative impacts of different polluting processes and apportion "blame".

However, while the assessment guidance acknowledges that environmental quality standards may vary from place to place (e.g. for rivers of different water quality classification), it does not provide any examples of this for air quality. In assessing the local impacts of a process emitting air pollutants, the critical nature of components of the local environment will need to be taken into account, i.e. are they CNC, CNA, etc.

The environmental quality standards are not able to achieve this. The Environmental Advisory Levels (EALs) set in guidance are largely based on human health criteria (an important component in achieving sustainable devlopment). EALs for the natural environment are being developed and it is likely that these would be different in different parts of the country. However, their development will be to set standards that are necessary to protect the most important species or habitats in an area. They will not distinguish between the relative importance of different local sites.

To assess these will require a second stage of analysis. If, after BPEO assessment, a process is emitting air pollutants which could result in ground level concentrations of concern, the nature of the local sites "at risk" should be assessed. The regulator ought not to have to undertake such assessment. While statutory conservation agencies will identify Sites of Special Scientific Interest (SSSIs) or other sites to HMIP, this will not indicate their identification in the framework of critical environmental capital. However, local authorities are identifying such sites in local plans and these may be the best sources of information. The exercise of Local Authority Air Pollution Control may also allow a number of local authorities to address air pollution issues in local plans as the expertise of such staff is used. Local authorities also have an important role to play in assessing pollution impacts of traffic flow and the incorporation of such analyses into that of the Environment Agency will be necessary to address Sustainable Development issues and air pollution.

It is important to remember that not all SSSIs may be classed as CNC, although

most will be and all others would be CNA. Also, some non-statutory sites may also be classed as CNC. A good example of this may be parks in dense urban areas. For CNC not given statutory conservation status it is important to identify the reason for its importance. Thus an urban park may be of great importance and need to be protected from building development, but may have little conservation interest that could be threatened by levels of air pollution that are generally acceptable, but which otherwise might be a problem for some conservation sites.

As a result it is obvious that while a road builder would have to address all CNC identified in a local plan as "equal", the pollution regulator would not necessarily do so as the same pollutant load may have very different impacts depending on why an area is identified as CNC. It is, therefore, important to discuss the implications for changes in air quality with all local interests in order to ensure that the implications for Sustainable Development are addressed correctly.

Principles of Action

The UK Strategy (Chapter 3) begins by stating that Sustainable Development aims to reconcile the needs of economic development without environmental deterioration.

It then outlines the following principles:

- Precautionary principle
- Polluter pays principle
- Environmental carrying capacity.

The precautionary principle is fundamental to the operation of the *Environmental Protection Act 1990.* The use of the principle is important where the following criteria are met:

1. Where the potential effects of releases are considered to be significant and/or irreversible.
2. Where gaps in knowledge lead to considerable uncertainty as to impacts.
3. Where the system is too complicated to ensure reliable predictions as to impacts.

Rather than being used simply to curtail economic development, the precautionary principle should be used as a spur to further scientific research to remove uncertainties. The Environment Agency will have a major role in identifying where such research is needed. The primary aim for industry and regulators should be to remove uncertainty in assessing pollution impacts.

The polluter pays principle has also been adopted in the *Environmental Protection Act 1990.* However, its application is limited in its scope. The operation of cost analysis in IPC or LAAPC is to ensure that the polluter pays the cost of the regulation. The polluter pays principle, however, aims to ensure that the polluter pays the full economic costs of the environmental consequences of the operation. While some of this is incorporated into IPC assessments, others, such as costs arising from waste arisings, are not.

Environmental carrying capacity, in effect, is a means of identifying what one can "get away with". This is linked in to identification of critical environmental capital and the setting of standards, which have been discussed previously.

Achieving Results

Technological developments will not provide a complete answer to achieving sustainability. There is a strong need for both the precautionary principle to be adopted in relation to ecological carrying capacities and for demand management techniques to be implemented to address consumption patterns that are destructive of those ecological carrying capacities. The Environment Agency cannot therefore achieve Sustainable Development merely by technological fixes, i.e. BAT is not sufficient. It must engage in demand management, waste minimisation, etc. The liaison with WRAs in the Agency will, therefore, be important.

An individual's environmental values can be incorporated when undertaking a broad environmental assessment of a project or policy. The Environment Agency could evaluate ways in which such assessments could be incorporated into its decision making. While probably not practical for individual IPC assessments, they might be for more general policy decisions. However, they could be incorporated into some more important IPC or radiological assessments if they have large public interest and would take time to process.

The integration of environment and development will be assisted by:

- economic incentives
- standards
- public information
- strategic and project environmental assessment
- establishment of environmental accounting and indicators.

The Environment Agency has a role in each of these:

A. Development of economic incentives is specifically identified as a preferred means of operation in the Environment Bill. As an alternative to regulation they need to be used to achieve tough environmental gains, rather than be a soft option. However, many significant economic measures would require Treasury approval at least and are, therefore, more difficult to implement than existing regulatory measures.

B. Standards. The setting of environmental standards is already acknowledged as part of the work of HMIP. However, it is worth assessing whether the full range of environmental standards possible is being addressed which relate to HMIP's area of regulation. The assessment and implementation of standards is fundamental to operation of the proposed local air quality management areas (DoE, 1995).

C. Public information is also important in the work of HMIP (public registers, CRI, ECOfacts, etc), DoE and local authorities. It is also an important component of the new DoE air quality strategy (DoE, 1995).

D. Environmental assessment is central to the operation of IPC and forthcoming guidance will enable a more comprehensive use of EA. However, EA for IPC is limited to the particular regulatory remit of IPC. Thus it would not include full analysis of issues such as waste minimisation or transport emissions. Such a full analysis would be necessary for assessment of Sustainable Development. Strategic EA is also very important and is perfectly applicable to industrial pollution. Current assessments

of critical loads and power station emissions fall into this category and its use ought to be assessed for wider application.

Environmental limits and standards need to be set in order to provide clear guidance for all operators. These include site specific (e.g. designated sites), critical loads (e.g. emission standards) and operating rules (e.g. pesticide regulations). HMIP has a central role in setting, enforcing and monitoring compliance with such standards.

Target Setting

Target setting is an important component of the Sustainable Development Strategy. There are two types of targets that the Environment Agency will have to address in assessing how its actions are helping to achieve Sustainable Development.

The first is to provide environmental data, i.e. monitoring information, on the state of the environment and identify where pollutant concentrations, deposition, etc, is unsustainable and whether the situation is improving or not. This requires information not only on pollutants, but also on those aspects of the environment which may be affected by pollution.

The second is to address the issue of whether the regulatory system is, itself, working. As it is obvious that air quality is not currently at levels consistent with Sustainable Development, some processes are emitting pollutants that are undesirable. How the regulatory system copes with this is the key determinand of its success. The control of unsustainable emissions from non-prescribed sources (e.g. traffic) remains a major area of regulatory development that is necessary in an overall strategy for achieving sustainable air quality.

Conclusions

The spirit of Rio seeks to ensure that this and future generations can meet essential needs and reasonable aspirations while enjoying an environment of quality; one that has some naturalness, one that supports global biodiversity and one in which natural assets — living components, and their non-living context, air, water and soil — are not degraded to a point that limits productivity or options for future use.

This does not mean business as usual. In many sectors of the economy we are on paths that will not deliver a sustainable future. The questions that have to be addressed are:

(a) what are environmentally sustainable lifestyles: with special reference to energy use, land use and transport?

(b) what are currently unsustainable sectors?

(c) what information do we need to define targets to aim for?

(d) how can we move towards these targets and within what timescale?

The crucial issue is the undervaluation of natural assets in conventional approaches to investment appraisal. We must give greater weight to environmental assets in decision making. Many assets are irreplaceable. Damage of these by development is

not environmentally sustainable because the continuing functioning of natural systems is part of the essential natural processes that support life. The Environment Agency will play a major role in ensuring full environmental accounting and in developing and implementing the concepts of Sustainable Development.

References

DoE (1995). *Air quality: meeting the challenge.* Department of the Environment, London.

English Nature (1994). *Sustainability in practice.* English Nature, Peterborough.

HMIP (1994). *Environmental, economic and BPEO assessment principles for integrated pollution control.* HMIP, London.

UPDATE

AIR POLLUTION MONITORING NETWORK

The Government is to complete the siting of stations comprising the Enhanced Urban Monitoring Network by the end of 1996 – one year earlier than previously planned.

Monitoring stations to measure levels of ozone, nitrogen oxides, sulphur dioxide, carbon monoxide and particulate matter will be established at Manchester, Glasgow, Sheffield, Nottingham, Bradford, Wolverhampton. Plymouth, Norwich and Stoke-on-Trent.

During the first phase of this initiative, begun in 1991, the following sites were established for the continuous measurement of O_3, NOx, SO_2, CO and PM_{10}:

> London (Bloomsbury)*; Belfast*; Edinburgh*; Cardiff*; Birmingham*; Newcastle-upon-Tyne; Leicester; Bristol; Hull; Southampton.

During the second phase the sites marked (*) were extended, and sites established at Middlesbrough, London (Eltham) and Culham to monitor 27 hydrocarbons (including 1, 3 butadiene and benzene). Further stations at Liverpool and Southampton will become operational during 1995.

Smoke and SO_2 are measured at a further 252 sites (of which 156 measure to ensure compliance with the relevant EC Directives); NO_2, and lead are also measured in compliance with EC Directives and more generally, there are 18 urban and rural sites for measuring ozone levels and a number of sites for measuring PAHs and metals.

VEHICLE POLLUTION

The Secretary of State for Transport, Dr. Brian Mawhinney has announced new measures aimed at cutting vehicle pollution. These follow roadside checks carried out on over 5,000 vehicles before Christmas 1994 which showed that the worst offenders were light goods

vehicles and taxis, followed by private cars.

The new measures include:

- Tighter MOT test standards for conventional petrol-engined vehicles and diesel-engined vehicles will be brought forward to 1 September 1995. For petrol-engined cars, light goods vehicles and other vehicles in the main MOT scheme, the amount of CO in a vehicle's exhaust gases should not exceed, for vehicles first used:

  – between 10 November 1973 and 1 October 1986: 4.5%
  – on or after 1 October 1986: 3.5%

For diesel-engined vehicles the level of smoke opacity should not exceed:

  – for non-turbocharged engines: 2.5 m^{-1}
  – for turbocharged engines: 3.0 m^{-1}

- Motorists and operators whose vehicle emissions are found to exceed prescribed limits at a roadside test will be issued with a delayed prohibition. Immediate prohibitions will be issued where emissions are so bad as to obscure the vision of other road users. Delayed prohibitions come into force 10 days after the notice has been issued whereas immediate prohibitions require the vehicle to be taken off the road straight away.

- Motorists will be allowed only 14 days (instead of 28) within which to notify the Vehicle Inspectorate that corrective action has been taken, an MOT test passed and the prohibition cleared at a police station.

- Operators of HGVs and PSVs will also be allowed a maximum of 14 days in which to respond to a prohibition notice. In most cases this will mean having any necessary defects corrected and re-presenting the vehicle to the Vehicle Inspectorate for confirmation of the action taken.

  Failure to comply with a prohibition notice will result in a prosecution. Evidence of lack of maintenance or a serious defect will automatically result in a prosecution as well as prohibition, and may result in a fine of £2,500 in the case of a goods vehicle or PSV or £1,000 for other vehicles.

IMPORT & EXPORT OF WASTE

The Department of Environment has published proposals for managing waste imports and exports; these will provide guidance for regulators and industry as to the types of shipment which will in future be allowed into and out of the UK, and those which will not. In particular, it helps towards achieving the Government's aim of self-sufficiency in waste disposal, both at national and European Community levels.

The key proposals of the management plan for imports and exports are:

- to ban exports from the UK for disposal to all countries;
- to allow exports for recovery to OECD counries but, in line with Decision II/12 taken by the Parties to the Basel Convention in March 1994, to ban exports of hazardous waste for recovery to non-OECD countries, other than in exceptional cases allowed under that Decision;
- to ban most imports for disposal, other than exceptionally in the case of hazardous wastes from develop-

ing countries which cannot reasonably deal with the wastes themselves, or for small quantities from developed countries where the provision of specialised facilites would be uneconomic. For wastes destined for high temperature incineration, the draft plan incorporates a three year transitional period during which progressively reducing volumes of imports would be allowed;

- to allow imports for recovery, whilst taking steps to ban imports for disposal under the guise of recovery — so called 'sham recovery'.

WASTE STRATEGY FOR ENGLAND AND WALES

The Government has published a draft waste strategy for England and Wales. The strategy aims to use the principles of sustainable development to provide a coherent framework for waste management policy and practice throughout England and Wales. It looks at the future aims and direction of waste management policy, and the role of industry, the public sector, consumers and householders in achieving those objectives.

The main targets outlined in the waste strategy are:

- to stabilise the production of households waste at its present (1995) level.
- to reduce the proportion of controlled waste going to landfill by 10% over the next 10 years; and to make a further similar reduction in the 10 following years.
- to recycle 25% of household waste by the year 2000.
- to increase the use of recycled waste materials as aggregates in England from 30 million tonnes pa at present to 55 million tonnes pa by 2006.
- 75% of companies with more than 200 employees to have published environmental policies covering waste issues by the end of 1999.
- 50% of companies with more than 200 employees to have management systems in place to give effect to their environmental policies by the end of 1999.
- close to home recycling facilities for 8 out of every 10 households by the year 2000.
- 75% of local authorities to actively promote composting by the year 2000.

RCEP AND INCINERATION

The Royal Commission on Environmental Pollution has confirmed its view that waste incinerators which meet present-day standards for emissions are an environmentally acceptable method of dealing with wastes which cannot be eliminated at source or recycled. In the case of municipal waste the Commission believes that incineration with energy recovery, followed by landfilling of the solid residues, will in fact prove to be the best practicable environmental option.

The Commission made a detailed study of waste incineration in its 17th report, published in May 1993. Among the factors considered were emissions of dioxins. The Commission has now reviewed its original conclusions in the light of two draft reports on dioxins published last year by the US Environmental Protection Agency, but says that nothing has emerged which would lead the Commission to alter the views

expressed in its 17th Report — i.e. that the standard set by HMIP of 1 ng TEQ/ Nm^3, with a guide value of 0.1 ng TEQ/ Nm^3, appeared appropriate in the present state of knowledge.

ASBESTOS EXPOSURE RISK

Roughly 1 in 100 of all British men now aged about 50 will die of mesothelioma according to a recent report by Professor Julian Peto, Cancer Research Campaign Professor of Epidemiology at the Institute of Cancer Research, London University, and colleagues from the Institute and the Health and Safety Executive (HSE). Building workers — particularly plumbers, gas fitters, carpenters and electricians — will account for about a third of all these deaths. However, if building workers and various other high-risk groups are not included, the mesothelioma risk to the rest of the population is very much lower.

In launching the report, which has been published in *The Lancet*, Dr Peter Graham of the HSE said that asbestos was extensively used in a wide variety of forms in building products during the 1950s, 60s and 70s because of its unique properties such as resistance to heat (when people born between 1940 and 1950 were beginning work).

The risk from asbestos is much less now than it was in the past, both because its use is now very strictly limited and the removal of asbestos insulation by licensed contractors is much better controlled. Concern now is focussed on workers who are casually exposed to asbestos dust and who — very often because of their youth or inexperience — are either not aware of, or tend to discount, the dangers. And although there is every confidence that the current legislation provides an adequate framework for preventing and controlling the risks of asbestos, its effectiveness depends upon everyone who works with asbestos being aware of its dangers and taking the necessary precautions to protect their long-term health.

Mesothelioma is currently responsible for more than 1000 deaths each year in the UK, the great majority of which are associated with exposure to asbestos. The other major fatal disease linked to asbestos is lung cancer. The incidence of these deaths can only be estimated because they are indistinguishable from lung cancers resulting from other causes such as smoking. However, it is estimated that for every death due to mesothelioma, there is at least one from asbestos-related lung cancer.

Together with the other serious asbestos-related disease, asbestosis, it was estimated that asbestos was currently responsible for about 3,000 deaths annually. The number of mesothelioma deaths was expected to go on rising very probably until 2010, and possibly up to 2025. There could eventually be a peak of more than 5,000 asbestos-related deaths annually.

"Continuing Increase in Mesothelioma Mortality in Britain", by Julian Peto, John T. Hodgson, Fiona E. Matthews and Jacqueline R. Jones, was published in *The Lancet* edition of 4 March.

NRPB INFORMATION

The NRPB has published a new edition of its radon broadsheet, in its "At-a-Glance" series. This describes the origins of radon, the levels in homes, and the ways in which radon is measured, it indicates the risks and the areas affected by radon, and it shows how levels of

radon can be reduced. Radon is the biggest source of radiation exposure of people in the UK – over 50% of the yearly radiation dose comes from radon on average and in some areas doses from radon are very high indeed.

Other publications in the "At-a-Glance" series are: Non-Ionising Radiations, Ultraviolet Radiation, NRPB At-a-Glance, Partners in Protection, Radiation Protection Standards, Radiation Doses – Maps and Magnitudes, Transport of Radioactive Materials, Nuclear Emergencies, Medical Radiation, Natural Radiation Maps of Western Europe, and Electric and Magnetic Fields from the Use of Electricity. They all rely heavily on illustrations but are underpinned by science. Slide sets based on most of these publications have also been produced. Single copies or small quantities of the broadsheets are available free of charge from Press and Information, NRPB, Chilton, Didcot, Oxon OX11 0RQ.

ENERGY FROM WASTE

The growing support for energy recovery from waste within an integrated waste management strategy has been underlined by the launch of the European Energy-from-Waste Coalition (EEWC).

The Coalition, whose members are drawn from raw material producers, converters, consumer product companies, waste management operators, energy producers and technology suppliers, aims to act as a principal voice in the energy-from-waste debate at the European level. By bringing together the spectrum of opinion and expertise on energy from waste, EEWC will present an up-to-date and accurate picture of its environmental performance, highlight the benefits which it can bring to communities and raise understanding of the technologies available.

EEWC places particular emphasis on the need to work closely with legislators, municipal authorities and environmental interest groups to encourage the development of new properly designed and operated energy-from-waste facilities.

The EEWC has three categories of membership: full (company); local authority; and institutional. For further information contact the EEWC at rue d'Arlon 50, 1040 Brussels. Fax: (+32-2) 280 18 83.

AUTOMATIC WEATHER MEASUREMENTS

The Met Office has recently published the above booklet, the main objective of which is to advise users of the need to adhere to standard methods of measurement, exposure and data processing to ensure that consistent observations are obtained. The booklet, which is primarily aimed at non-meteorologists, also gives attention to data transfer formats to enable data exchange between users, and highlights the difficulties of measuring in urban areas.

This booklet is available free from Mr. B. Tonkinson at The Met Office, Commercial Services, Johnson House (JG 10), London Road, Bracknell, Berkshire RG12 2SY. Fax: 01344 854906.

ENVIRONMENTAL INDUSTRIES COMMISSION

Launched in April, the EIC aims to provide an effective voice for the UK's environmental technology and services industry.

The Commission's main role will be to lobby for UK and EC Government support through the introduction of economic instruments (e.g. tax relief and R & D funding), tighter enforcement of existing legislation and enactment of technology forcing standards, in line with Government practices in other countries. The Commission will also:

- identify the barriers to growth facing the British environmental industry;
- promote awareness of the commercial and environmental benefits of environmental technologies and services;
- organise an education programme targeting mainstream industry to promote the use of environmental technologies and services.

The Commission's President is Lord Gregson, and it already has a number of leading politicians, industrialists, trade union leaders, environmentalists and academics on its advisory committees.

NEIGHBOUR NOISE

Last October, the Environment Minister set up a small working party to review the effectiveness of neighbour noise controls. The working party's recommendations have now been published as a consultation paper and include the following:

— Good practice guidance should be made available to local authorities (LAs) on the management of noise services.

— LAs should be encouraged to provide information to residents about their authority's noise complaints service and to increase public awareness of neighbour noise issues. Government should consider supporting publicity initiatives to increase awareness of what constitutes unacceptable noise.

— Consideration should be given to issuing general guidance on the sorts of noise problems which might constitute a statutory nuisance.

— LAs should be encouraged to provide services which respond to complaints outside working hours wherever such services are required.

— LAs should be encouraged to establish streamlined local arrangements for obtaining warrants to enter domestic premises to temporarily confiscate noise-making equipment or silence intruder alarms.

— Code of good practice should be issued jointly by the professional representative bodies to police forces and LAs to encourage effective local arrangements for dealing with noise complaints.

— A specific power of temporary confiscation of noise-making equipment (to provide a stronger legal base for existing practice) should be introduced, with the power for LAs to levy an administration charge for its return.

— LAs should be encouraged to seek, where appropriate, deprivation orders for the permanent confiscation of noise-making equipment following prosecution.

— Consideration should be given to the creation of a criminal offence, separate to the statutory nuisance regime, to apply to night time neighbour noise disturbance.

NSCA's initial response to these proposals appears earlier in this issue of *Clean Air*.

BOOKS AND REPORTS

ENVIRONMENTAL ISSUES AND THE EUROPEAN MOTOR INDUSTRY

A. Way, N. Wemyss, Financial Times Management Reports, 1995. £280 ISBN 1853342645.

Divided into two sections, this report gives an overview of environmental issues confronting the motor industry. A chapter on exhaust emissions compares EU legislation with US, in particular, Californian, standards and looks at petrol and diesel emissions and markets. Electric and hybrid vehicles, recycling, manufacturing processes and congestion are also considered. The second section examines environmental initiatives at selected manufacturers with a European base — BMW, Fiat, Ford, General Motors, Mercedes Benz, Nissan, Peugot-Citroen, Renault, Volkswagen and Volvo.

THE FUTURE OF ENERGY USE

R. Hill et al. Earthscan, 1995, £14.95 ISBN 1853831077

The availability and price of energy and the technologies for transferring it into goods and services is a central issue in sustainable development. This book outlines the concepts and provides detailed figures on energy consumption and output necessary to appreciate the complexities of its subject. It examines the uncertainties of estimating non renewable resources and the potential of techniques of exploiting renewable resources. Appendices on units and conversion factors and cost-benefit analysis make this the source book we have been waiting for.

EU ENVIRONMENT GUIDE 1995

EC Committee of the American Chamber of Commerce, ISBN 2-90073-12-8, November 1994. BEF 1500. Available from: Avenue des Arts 50, Bte 5, B-1040 Brussels, Belgium.

Published annually, this up-to-date and comprehensive guide provides an invaluable information source on environmental issues, developments, programmes and organisations. Full details of the reorganisation of the European Commission's DG XI, which became available after the book went to print, are given on a separate chart in poster format. The Guide also provides details of a wide range of organisations active in the environmental field, including the institutions of the European Union. Finally the Guide offers an insight on EU environmental policy and its implications on business, and a study of the environmental policies in Central & Eastern Europe and the United States.

NOISE CONTROL
The Law and Its Enforcement

C.N. Penn, Shaw and Sons, 1995. £24.95 ISBN 0721908314.

Updated to 1 December 1994, this book is a comprehensive and accurate guide to the law relating to noise. An introductory chapter looks at noise and sound, noise measurement and reduction. Sources of individual noise problems, their effects and possible methods of control are examined. This thorough guide to all aspects of the legislation is illustrated with case law.

STATE OF THE WORLD 1995

L.R. Brown et al, Worldwatch Institute, Earthscan, 1995. £12.95, ISBN 1853832472.

The 12th annual Worldwatch report includes papers on declining fish stocks – as just one example of the economic and social costs of unsustainable harvesting of natural resources; solar and wind energy; building construction; ecoystem conservation and disarmament. As ever it provides an invaluable and instructive contemporary overview of the state of policies and problems worldwide in an environmental context.

SOCIAL THEORY AND THE GLOBAL ENVIRONMENT

ed. M. Redclift, T. Benton, Routledge, 1995. £12.99, ISBN 0415111706.

Leading social scientists explore the relationship between social theory and sustainability. They stress the need for acknowledgement of the role of cultural, economic and political values in shaping the definitions of environmental problems. The contributors are international social scientists with long standing interests in environmental issues.

FUTURE EVENTS

9-12 MAY – HAZARDOUS WASTE MANAGEMENT
Introductory short course run by the Centre for Hazard and Risk Management at Loughborough University of Technology.
Details: Joyce Motyka, Tel: 01509 222175. Fax: 01509 610361.

11-12 MAY – ENVIRONMENTAL RISKS AND REWARDS FOR BUSINESS
Coinciding with a new era in the direction of the European Commission and a new era for competition within the global economy under GATT, this conference aims to provide an insight into the shape of things to come for business and the environment; organised by the EU-LEX International Practice Group and The Centre for Environmental Law and Policy at LSE.
Venue: Copenhagen.
Details: Ariel Lees-Jones, Tel: 0161 839 9005; Fax: 0161 839 9006.

22 MAY – MUNICIPAL WASTE INCINERATION

It is likely that greater regard will be paid by planning authorities to the MSW incineration option, with those promoting landfill having difficulty in establishing that it is the BPEO. This conference will bring delegates up to date on the market signals which must reflect the non fossil fuel options and the landfill levy. Risk assessment, EMS and eco-audit will be covered.

Venue: London Kensington Hilton.

Details: Sally Bate/Amanda Jones, IBC Technical Services. Tel: 0171 637 4383.

23 MAY – WORK BASED LEARNING PARTNERSHIPS

This conference will provide a forum for those involved in policy and practice to exchange and develop ideas. It will also seek to make recommendations for work based learning and professional development in the future.

Venue: CBI, London (to be confirmed).

Details: Conference Organiser, National Centre for Work Based Learning Partnerships, Middlesex University, Tel: 0181 362 6086; Fax: 0181 362 6118.

24 MAY – TRANSPORT AND THE ENVIRONMENT – THE END OF THE ROAD

With a sub-title of "Options for sustainable policy and practice", speakers will examine current understanding of the implications of transport systems for air and water quality for the physical environment, for shoppers, shopping and shops in the community and for the "sustainable city" in strategic terms.

Venue: Church House Conference Centre, London.

Details: The Chartered Institution of Water and Environmental Management. Fax: 0171 405 4967.

24-25 MAY – ADVANCES IN ENVIRONMENTAL AUDITING

Conference speakers will explore 'state of the art' environmental management and auditing. An integrated approach to auditing health, safety and environmental issues will also be examined. IBC Technical Services in association with the Institute of Environmental Assessment.

Venue: The Café Royal, London.

Details: Sarah Mobsby/Amanda Jones. Tel: 0171 637 4383.

28 MAY-2 JUNE – 10th WORLD CLEAN AIR CONGRESS AND EXHIBITION

Growing challenges – from local to global: papers and posters on topics ranging from local and regional air quality problems to global issues; main themes include emissions and control; atmospheric dispersion and air quality; impacts; politics.

Venue: Helsinki, Finland

Details: Ms Suvi Saxén, Tel: +358-0-175355; Fax: +358-0-170122. Copies of the programme are also available from Wendy Messer at NSCA, Tel: 01273 326313.

15 JUNE – NSCA SEMINAR: PLANNING AND AIR QUALITY

The aim of this seminar is to improve understanding between air quality managers and

planners, and to identify areas where research, development or training will be needed.
Venue: NEC Birmingham.
Details: NSCA, Tel: 01273 326313; Fax: 01273 735802.

26-30 JUNE – ACID REIGN '95?
While the conference will focus on acidification, it will also cover regional air pollution problems more broadly. It will provide opportunities for the presentation of scientific results and their implications for national and international policies.
Venue: Gothenburg, Sweden.
Details: Swedish Exhibition Center, Box 5222, S-402 24 Gothenburg, Sweden.

3-4 JULY – ECO-MANAGEMENT AND AUDITING CONFERENCE
Aimed primarily at those interested in corporate environmental performance but also of interest to local authorities. EMAS, BS 7750, ISO 14000, environmental auditing. etc will be covered.
Venue: University of Leeds.
Details: ERP Environment. Tel: 01274 530 408. Fax: 01274 530409.

11-13 SEPTEMBER –
18th INTERNATIONAL CONGRESS FOR NOISE ABATEMENT
Acoustics and traffic noise are to be the two main themes of this Congress which will also include an exhibition of scientific instruments, software and acoustical material.
Venue: University of Bologna, Italy.
Details: Willy Aecherli, Mirschenplatz 7, CH 6004 Luzern. Fax: +41-41 529093.

CLEAN AIR INDEX
VOL 24, 1994

CLEAN AIR

AND ENVIRONMENTAL PROTECTION

SUMMER 1995

Volume 25 Number Two

NATIONAL SOCIETY FOR CLEAN AIR AND ENVIRONMENTAL PROTECTION

SUMMER 1995
VOLUME 25
ISSN 0300-5734

CLEAN AIR

Publishing Director:
Dr. Tom Crossett
Secretary General, NSCA

Editor:
Loveday Murley

Information/PRO:
Tim Brown

Advertising:
Sally May
Rates on request.

CLEAN AIR is issued free to Members and Representatives of Members.

CLEAN AIR Subscription for 1995 – £24.00

CLEAN AIR is printed and published in England by the National Society for Clean Air and Environmental Protection, 136 North Street Brighton BN1 1RG
Tel: 01273 326313
Fax: 01273 735802

CONTENTS

HONORARY SECRETARIES OF NSCA DIVISIONS

Scottish Division: Calum MacDonald – Telephone: 0141 227 5552
City of Glasgow DC, Environmental Health Dept, 23 Montrose Street, Glasgow G1 1RN

Northern Ireland Division: Mervyn Fleming – Telephone: 01232 401805
67 Kilwarlin Road, Hillsborough, Co. Down BT26 6EA

Northern Division: Keith Atkinson – Telephone: 01325 388552
30 Loraine Crescent, Darlington, Co. Durham DL1 5QU

North West Division: Neil Turner – Telephone: 0151 443 4731
45 Down Green Road, Harwood, Bolton BL2 3QD

Yorkshire & Humberside Division: Stephen Carden – Telephone: 01924 295391
City of Wakefield MDC, 29 King Street, Wakefield WF1 2SY

West Midlands Division: John Sweetland – Telephone: 01952 202558
Senior EHO, Pollution Control, Wrekin Council, Civic Offices, PO Box 212, Telford TF3 4LB

East Midlands & Eastern Divisions: Dr. Bill Pearce – Telephone: 01623 656656, ext. 3139
Environmental Health Services, Mansfield DC, Civic Centre, Chesterfield Road South, Mansfield, Notts NG19 7BH

South East Division: Joe Beagle – Telephone: 0181 452 0203
19 Oxgate Gardens, Brent, London NW2 6EA

South West Division: Peter Gendle - Telephone: 01934 634839
Environmental Health Dept, Woodspring DC, PO Box 143, Town Hall, Weston super Mare, Bristol BS23 1AE

South & Mid Wales Division: Terry Jones – Telephone: 01495 766775
28 Maes-y-celyn, Griffithstown, Pontypool, Gwent NP4 5DG

EDITORIAL

THE NEXT VITAL STEPS

The new Environment Act has the potential to become the most powerful piece of air pollution legislation since the first *Clean Air Act*. It did not have an auspicious beginning; when the Bill was first published it contained no mention of air quality management (AQM). However, thinking on the subject was already well advanced. In discussions with the Department of the Environment and other interested bodies, NSCA had sought to influence the policy debate which led to *Improving Air Quality* and subsequently *Air Quality – Meeting the Challenge.*

It is a tribute to the breadth of the Society's membership that it was able to promote a consensus view on the framework for AQM based upon sound science and practical experience of local implementation. Against this backing (and drawing upon their own authority as past members of the Royal Commission on Environmental Pollution and leading thinkers on environmental protection) Lord Lewis and Lord Nathan, the Society's President and Vice President, presented to Parliament a compelling case for amending the Bill to give immediate effect to the Government's own proposals.

To their credit, Ministers willingly conceded the point in debate. An eleventh-hour amendment at the Bill's Committee Stage introduced the framework for AQM, much as the Society had wished. With the legislation in place we now wait to see whether its potential will be fulfilled. Air quality management areas could be established over large parts of the UK, or could be confined to tiny polluted pockets, depending upon the air quality standards and targets chosen by the Government. Local authorities could take a crucial role in developing cost-effective AQM action plans, or they could be relegated to the sidelines, depending upon the guidance issued and the resources made available.

The next few months will see flesh put on the bones of the new framework and it is important now to start bringing the key players together. Within local authorities those traditionally responsible for air quality must make links with planners, highways engineers, environmental policy co-ordinators and economic development officers at district and county level. Strategic discussions must be held with industry, commerce, and others with influence over local emissions. Finally, contact must be established with local health managers to explore ways

of assessing whether the ultimate goal of AQM – a reduction in the health impact of air pollution – is actually being achieved.

NSCA has led from the front on AQM – just as we did with the *Clean Air Act* forty years ago. Discussions at Divisional level, feedback from regional pollution control groupings, the expert advice of our specialist AQM working group, and contact with other interested bodies have all contributed to this effort. Members who wish to see the full potential of the new Act realised are urged to participate in the continuing debate, and to request any information they may need from the Society's officers – after all, we are here to serve our members.

We look forward to greeting many of you at our annual Conference in Scarborough where we will hear at first hand what Ministers have in mind for the next vital steps. Hopefully we will have some cause to celebrate.

NSCA NEWS & VIEWS

NATIONAL AIR QUALITY STRATEGY

Government amendments accepted at the Committee Stage of the Environment Bill will give effect to the plans for local air quality management (LAQM) outlined in the recent DOE/DOT policy paper *Air Quality – Meeting the Challenge*.

NSCA welcomed this step as representing the most dramatic step forward in air pollution legislation since the *Clean Air Acts*. The Bill now requires the Environment Secretary to prepare a National Air Quality Strategy, including air quality standards for a range of pollutants. Most of the implementation of the plan will depend on local authorities. All district and unitary authorities will be under a duty to review air quality in their area, and identify where air quality standards are likely to be breached. These areas will be designated by Order as air quality management areas; for each AQMA the local authority concerned will draw up an action plan to show how it will meet air quality standards in future.

For most AQMAs traffic pollution is likely to be the number one problem. Districts currently have limited powers in this area; the Bill will also require a two-way process of consultation and information exchange between districts and counties, so that a coordinated approach to transport planning can be developed. Counties can make recommendations to districts on their review process and any subsequent action plans.

Although lower-tier authorities will do much of the pollution monitoring and assessment work and draw up action plans, counties and highways authorities will have a role in producing the transport policies and planning measures which will deliver clean air. Reserve powers allow the Secretary of State to direct any authority to take measures if action plans seem unlikely to achieve air quality standards, and to force authorities to cooperate if voluntary agreements are ineffective.

Wide-ranging powers to make regulations are written into the Bill, including prohibitions or restrictions on vehicles or industrial processes, issuing public information on air quality, and fixed penalty provisions (likely to be linked to vehicle spot checks).

Later this year should see the publication of the draft national strategy and the first local authority guidance. Planning policy guidance notes on transport and pollution are already being revised in preparation. Pilot studies for air quality management areas in Kent, Surrey, Sheffield and Middlesbrough are under way.

The Bill sets out the strategic framework for LAQM. Once this is established local authorities will be faced with the question of which management tools are available to them – in other words, what can actually be done to reduce air pollution to meet air quality standards? NSCA has argued for the principle of local choice from a national menu of

control options, but the current menu is inadequate. Further options could include:

- Traffic management – short term measures to close roads and divert traffic during pollution episodes are in many ways an admission that a long-term strategy has failed; long-term management measures designed to reduce and/or smooth traffic flow will clearly assist LAQM.
- Powers to detect and test polluting vehicles.
- "Stage II" controls over petrol station emissions where benzene is a problem.
- American-style "Commute Option" programmes – requiring major employers to reduce the number of single-occupancy car commuter trips. This could include private transport, financial incentives to discourage car use, car pooling/sharing, etc.
- A similar requirement for schools to devlop plans to reduce "school run" commuting – school buses, guided walking, assisted/safe cycling, etc.
- Positive promotion of mass transit systems, cycling and walking.
- Planning and fiscal measures to reduce – or tax – parking provision.
- Powers to require the use of reformulated or alternative fuels – particularly for public service diesel vehicles – in AQMAs.
- Powers over the use and sale of solvents – dry cleaners, DIY outlets, small vehicle respraying paintshops, where ozone is a regional problem.

NSCA believes that local authorities must start to open up new channels of communications – between departments, with other authorities, and with other key playes – to plan ahead for air quality management. For many it will become a central factor in the Local Agenda 21 process.

Meanwhile the major question mark lingering over the Environment Bill is not whether the Government is serious about tackling air pollution, but whether it will give local authorities the resources and tools to do the job.

REVIEW OF THE EFFECTIVENESS OF NEIGHBOUR NOISE CONTROLS

Department of the Environment Consultation

Last October the Environment Minister set up a small working party to review the effectiveness of neighbour noise controls and to recommend whether any new mechanisms for controlling this growing problem were needed. The working party's recommendations were published as a consultation paper in March of this year. NSCA's response follows.

Introduction

NSCA surveyed local authority neighbour noise control policy in 1994[1]. We found that LAs have seen an increase in workload due to noise complaints. About a third think that the law controlling noise as it stands is inadequate; slightly more say the law would be adequate, if they were given more resources for enforcement.

In particular LAs would like to see new legal powers to tackle one-off noisy events, and some foresee an increasing role for the police. We found that the noisy party problem is widespread and a number of authorities have successfully confiscated sound equipment, generally with police cooperation. It should be noted that in Scotland the scale of the problem, and the legal framework, differs from the rest of the UK.

It is important to distinguish between persistent nuisance problems which do not require an immediate response to complaints, but may need to be investigated out of hours; and one-off noisy events which may need an immediate response, perhaps with police involvement.

NSCA believes that current legislation (*Environmental Protection Act 1990* – EPA 1990) is largely adequate for the first category and that the main problem is lack of resources. For the second category, the current framework is adequate in theory but is proving inadequate in practice. There is no consensus about whether this primarily reflects a lack of enforcement powers or resources.

Discussions about new legislation should not divert attention from the fact that noise enforcement is a resource-intensive activity. Any legislation requires political commitment at both local and national level to provide the necessary resources for noise control. Our local authority advisors suggest that the initial cost estimate of £1-3M given in the covering letter to the consultation paper is too low, perhaps by a factor of four. The Government is right to respond to public concern on noise issues, and new legislation gives the impression of resolute action, but a willingness to provide resources for enforcement will be the true test of its commitment.

Comments

NSCA's comments on the nine key recommendations emerging from the review process follow.

R1 Good practice guidance should be made available to local authorities on the management of noise services.

We support this recommendation. NSCA's own Local Authority Neighbour Noise Guidelines[2] have been enthusiastically adopted by many LAs. It may be that an update of the NSCA Guidelines could, following consultation, form the basis of good practice guidance. In particular, guidance should address the cost-effectiveness of different management options and the availability of staff to respond to noise complaints.

Specific reference is made to the use of informal remedies such as mediation. The place of informal remedies remains unclear, since EPA 1990 places a specific requirement on LAs to investigate complaints, and to serve an abatement notice where nuisance is likely to occur or recur. Mediation does not appear to meet the requirements of EPA to investigate alleged neighbour nuisance. Further evaluation of the effectiveness of informal remedies, and clarification of their legal status, would be welcomed.

R2 Local authorities should be encouraged to provide information to residents about their authority's noise complaints service and to increase public awareness of neighbour noise issues. Government should consider supporting publicity initiatives to increase awareness of what constitutes unacceptable noise.

We support this recommendation. An increasing number of LAs produce their own advisory leaflets, and many use NSCA information leaflets to give impartial guidance. Wider educational work is undertaken by some local authorities, often using NSCA teaching materials. Such activity will have long term benefits and needs to be supported with earmarked resources.

Beyond this, there is a need to promote agreed cultural norms and a climate of social responsibility on noise matters. This has certainly occurred within the last few years as noise issues have been debated regularly in the media. However we must question whether the real "targets" are being hit, and accept that some noisemakers simply do not believe that they owe any duty to the community. The Government does have a role here, but has yet to develop a coherent strategy.

R3 Consideration should be given to issuing general guidance on the sorts of noise problems which might constitute a statutory nuisance.

Given the inconsistent approach taken by the courts, guidance could certainly be issued to magistrates on this matter. A central summary of relevant precedents and case law would also be of assistance to LAs. A review of noise standards and guidelines would also be useful.

Care must be taken in giving specific guidance such as "x level of noise at y time of night is likely to constitute a nuisance" because of the implication that slightly less than x or slightly earlier than y would be unlikely to constitute a nuisance.

R4 Local authorities should be encouraged to provide services which respond to complaints outside working hours wherever such services are required.

We support this recommendation, which echoes the NSCA LA Guidelines. It should be recognised that significant resource implications may arise from this recommendation. As noted in our response to R1, guidance should address the cost-effectiveness of different management options and the availability of staff to respond to noise complaints.

R5 Local authorities should be encouraged to establish streamlined local arrangements for obtaining warrants to enter domestic premises to temporarily confiscate noise-making equipment or silence intruder alarms.

Again, we support this recommendation, which echoes the NSCA LA Guidelines. Many LAs are in the process of improving arrangements and examples of good practice should be circulated as quickly as possible.

R6 Code of good practice should be issued jointly by the professional representative bodies to police forces and local authorities to encourage effective local arrangements for dealing with noise complaints.

NSCA has been pressing for a memorandum of understanding on this matter and we welcome the recommendation. Noise enforcement is potentially confrontational and there are clearly some circumstances in which it would be essential to have police support for LA officers.

The degree of cooperation with police varies widely across the country and in the absence of formal agreements depends upon local personalities and attitudes. Police representatives tell us that noise control is very low on their list of priorities, but there are

examples of local authority officers working in tandem with police to provide rapid and effective response to noise problems. A change in Home Office priorities for police enforcement activities could improve the noise climate very quickly indeed.

R7 A specific power of temporary confiscation of noise-making equipment (to provide a stronger legal base for existing practice) should be introduced, with the power for local authorities to levy an administration charge for its return.

Some LAs are already experimenting with existing powers; any strengthening and clarification of such powers would be welcomed. Questions of LA responsibility for damage, loss, or ultimate disposal of impounded equipment must be addressed. In Scotland, existing powers are probably adequate for this purpose.

R8 Local authorities should be encouraged to seek, where appropriate, deprivation orders for the permanent confiscation of noise-making equipment following prosecution.

Again, strengthening and clarification of existing powers would be welcomed. Questions of appeals and associated costs must be addressed. In Scotland the Courts already have appropriate powers.

For both R7 and R8 the question of impounding noisy animals might also be considered.

R9 Consideration should be given to the creation of a criminal offence, separate to the statutory nuisance regime, to apply to night time neighbour noise disturbance.

There are widely differing views on this proposal, perhaps because of the considerable number of competing advantages and disadvantages. However we can state with confidence that, if the other eight recommendations above were implemented swiftly, the need for R9 would be much reduced. Rather than rush into new legislation we believe there is an argument for implementing the less contentious recommendations first. Only if these prove inadequate, and then only if the technical and practical issues identified below can be resolved, would it be appropriate to proceed with new legislative powers.

Comments were invited on a number of different aspects of this recommendation:

-a- Proposal to make night time neighbour noise a criminal offence.

The proposal would streamline the LA response to certain kinds of noise complaint and could act as a deterrent. Confiscation of equipment would be immediately effective, and has an element of natural justice. Set against these advantages, the proposal sits uneasily with the flexibility offered by statutory nuisance legislation, is potentially confrontational, and raises a number of technical and practical difficulties.

One major issue is whether the powers proposed should be adoptive. We question whether there is any precedent for an activity being a criminal offence in some parts of the country, and not others. Furthermore, since the offence is based on an objective measurement over background noise levels, this would appear to legitimise higher levels of noisemaking in already noisy areas. On the other hand, there may be a case for allowing local flexibility, and even setting different times for the night noise period, to take account of local social norms.

-b- The fixed penalty option.

Whatever level of fixed penalty is set, there will be some for whom it would represent an acceptable cost for a noisy party, and others who would be unable to afford to pay and would be taken through the courts in the usual way. The imposition of a fixed penalty would be confrontational and potentially dangerous in situations where alcohol or drug abuse were likely; a police presence would be essential. LA officers already have the power to serve abatement notices and confiscate equipment with police support, powers which would be consolidated by adopting R5, R6, R7 and R8 above. The additional benefits of a fixed penalty appear to be marginal.

Practical difficulties may well arise in identifying a responsible person. It is not clear from the consultation paper who would be responsible for collecting fines, or what would be the ultimate fate of any resulting revenue.

-c- Whether the new offence might apply to the whole or part of a LA area.

See comments at (a) above on adoptive powers.

-d- The night period to which such an offence might apply.

See comments at (a) above on adoptive powers.

-e- The interval for a repeat offence.

Repeating the offence on the following, or any subsequent, day would seem reasonable.

-f- The technical merits of different means of measuring and assessing neighbour noise.

NSCA has collaborated with the Building Research Establishment in promoting field trials of an objective assessment method for determining noise nuisance[3]. The results suggest that an objective test method can support the subjective assessment of a definite nuisance by a trained officer, but cannot help in discriminating between marginal cases. More work is clearly necessary before we can determine whether an objective method can be developed for evaluation of statutory noise nuisance.

The objective method proposed in the consultation paper is more of a "coarse filter" to identify a definite nuisance. As with other standards (such as BS4142) there is a danger that the 35dB(A)/10dB(A) exceedance criteria could become established as a factor in legal argument and thus prejudice statutory nuisance actions.

The 35dB(A) figure is acknowledged to be based on limited data and is proposed in the absence of any other appropriate benchmark. Further evaluation of this level should be considered, particularly in the light of the likely low-frequency component of amplified music. Difficulties can be envisaged in determining the existing background, where the noise complained of is continuous.

In the light of these uncertainties, we feel it important that legislation should not specify any particular noise level as a criterion of exceedance. This should be left to subsequent regulations, and subject to possible modification as research and practical experience is evaluated.

-g- The time to elapse before an offence has been committed.

Five minutes would seem a reasonable time to allow the noise to be terminated.

-h- The proposed power of temporary confiscation of noise-making equipment.

As noted in our response to R7 and R8 above, strengthening and clarification of existing confiscation and deprivation powers would be welcomed. Confiscation could then be used more widely as a sanction under existing legislation without necessarily requiring a new offence to be created. However, if a new offence *were* created there would be advantage in specifying confiscation powers; in many ways this is likely to be a more effective remedy than the issuing of a fixed penalty.

-i- Any other options which would enable LAs to swiftly remedy neighbour noise nuisance.

We consider that there should be a facility to serve abatement notices on the occupier of premises if the person responsible or owner cannot be readily identified. Guidance could be issued on the bounds of "unreasonable" time and effort spent identifying the person responsible for creating noise.

The consultation paper gives little guidance on the steps which LAs can take when the problem is clearly due to inadequate sound insulation. Even the recent introduction of insulation standards for flat conversions does not apply to houses in multiple occupancy. However we welcome the acknowledgement that improved compliance with current sound insulation standards is an important issue and look forward to further policy initiatives in this area.

References

(1) Implementation of Noise Nuisance Legislation. NSCA 1994.

(2) Neighbour Noise Problems: NSCA Local Authority Guidelines. NSCA, 1994.

(3) An Investigation into a Method for the Assessment of Disturbance Caused by Amplified Music from Neighbours. C Grimwood & N Tinsdeall, Acoustics Bulletin March/April 1995.

ENVIRONMENT COMMITTEE INQUIRY
BURNING OF SECONDARY LIQUID FUEL IN CEMENT KILNS

The House of Commons Environment Committee is currently carrying out a short inquiry into the burning of secondary liquid fuel in cement kilns, with the intention of resolving some of the controversies surrounding the issue. The Inquiry hopes to provide a forum for debate and exchange of information between all the interested parties – the cement and waste incineration industries and regulators.

NSCA COMMENTS

In its submission to the Committee NSCA suggested that in many ways the issue represents a model for the application of environmental risk assessment to industrial pollution control and the examination of public confidence in the regulatory framework.

Essentially there are three issues to be addressed:

- Is there an environmental case for burning waste solvents in cement kilns?
- If so, what emission standards should apply?
- How can standards be enforced to the satisfaction of local communities?

1. Is there an environmental case for burning waste solvents in cement kilns?

Incineration represents the BPEO for the disposal of some waste solvents. The Society believes that the use of waste solvents in cement kilns is acceptable, and may on occasion be desirable for reasons of energy efficiency, provided that the fuel composition, operating conditions and emission limits are specified and monitored in relation to environmental risks.

2. What emission standards should apply?

The disparity between emission standards for waste incinerators and waste-derived fuel combustion processes has been the subject of controversy since the introduction of IPC. There has been a presumption that incinerators deal with heterogeneous material and that emission standards should be set more tightly to take account of this variability. If waste solvent "fuel" has a well-defined specification which can be related with confidence to the combustion conditions in a cement kiln and the likely emissions, there would appear to be a case for treating it as a relatively homogeneous input and setting emission standards on a sliding scale between kiln standards and incinerator standards *pro rata* to solvent input. Clearly fuel specifications should be set with precaution; we believe that a halogen content of more than 1% should only be justified on the basis of a conservative analysis of environmental impact.

3. How can standards be enforced to the satisfaction of local communities?

If HMIP is confident that emissions from the combustion of waste solvents in cement kilns present an acceptable risk to human health and the wider environment, but fails to communicate this confidence to the local community, it is falling down on the job.

The Inspectorate is undertaking a public consultation on the burning of Cemfuel at the Castle Cement works in Clitheroe. This is the first practical use of the BPEO Environmental Assessment procedure currently being developed by HMIP. One could query whether this is in fact a BPEO assessment, since alternative disposal options to different media are not considered. However, although the Society has misgivings about the procedure itself, we welcome the openness with which the exercise has been undertaken.

Our first impression is that the monitoring work undertaken for the exercise and the interpretation of the resulting data falls short of the standards which we would expect to see. Sampling under field conditions calls for specialist skills and experience, and it is to be regretted that the sampling was not undertaken by one of the now-disbanded HMIP sampling teams.

It is also unfortunate that the kiln selected for tests was "operating towards the end of its campaign life". This has made the test results difficult to compare with the results of previous testing and failed to show the reductions in sulphur and NO_x anticipated by Castle. There appear to be further anomalies on assertions relating to emissions of organics, nickel, chromium and acid halides.

Setting aside concern about the quality of the report, there does not seem to be much attempt to make the issues accessible to the lay person. Local people and the elected members who represent them are unlikely to be much the wiser. Essentially, the Castle exercise suggests that HMIP does not currently have the resources to undertake an adequate assessment of the potential environmental impact of waste solvent fuel, to take full control of enforcement monitoring (both fuel specification and emission compliance), nor to engage the local community in useful dialogue. Unless HMIP can fulfil its role as a trusted intermediary between industry and community, the true costs and benefits of waste solvent burning will remain the subject of ill-informed debate.

IPR PROCESS GUIDANCE NOTES SERIES 2

There is a general commitment on the part of HMIP to review and update Integrated Pollution Regulation Notes (IPR Notes) not more than every four years. Thus, HMIP is now circulating draft revisions to IPR Notes relating to the fuel production and combustion processes.

NSCA COMMENTS

In a letter to HMIP in May, NSCA outlined a generic concern which the Society has about about the approach to BATNEEC and BPEO in the draft revised Notes. One of the objectives in the draft Guidance to the Environment Agency is *"...to adopt an integrated approach to environmental protection and enhancement which considers impacts of substances and activities on all environmental media and on geographic regions."* [Para 3.3 (a)]. This implies that BATNEEC and BPEO should take more account of industry-wide factors, and are not exclusively site-specific.

The Environmental Performance Review undertaken by the OECD in 1994 said:

> 'The United Kingdom's IPC system is narrow. The 1991 OECD Council Recommendation on integrated pollution prevention and control states that the concept means "taking into account the effects of activities and substances on the environment as a whole and the whole commercial and environmental life cycles of substances when assessing the risks they pose and when developing and implementing controls to limit their release". This means dealing with inputs as well as emissions, and with the full life cycle of products'.

HMIP currently is unable to promote a truly integrated approach to pollution control, and can only apply the concept of BPEO at plant level. Even at plant level, HMIP has been reluctant to exercise its theoretical powers over inputs to industrial processes, only the end-of-pipe outputs. It has therefore done very little to encourage energy efficiency, waste minimisation, or the use of cleaner technologies through the authorisation procedure. Furthermore, HMIP has been unable to take account of wider environmental impacts in determining BPEO at plant level. For instance, the use of flue gas desulphurisation at a power station may be justified in isolation, but in the national context there may be a better mix of environmental options for the national combustion plant emissions bubble, which HMIP is currently unable to promote.

We believe that IPR Notes are not intended to be process-prescriptive, but to give guidance on the emission concentrations which are achievable from the best available technologies, and to set minimum standards which existing and new plant should be expected to meet as BATNEEC. Tighter emission standards may be appropriate for individual plant where local environmental quality standards are at risk.

Process guidance preference for a particular technology is justified only if the underlying reasoning is robust. We are concerned at apparent inconsistencies in the treatment of different technologies; for instance HMIP appears to be promoting integrated gasification combined cycle (IGCC) as BAT for power generation from coal, bitumen emulsions and refinery residual oil in Notes 1.01 (Combustion Processes <50 MWth) and 1.11 (Gasification of Solid & Liquid Feedstocks). This does not adequately acknowledge alternative "clean" technologies or take account of efficiency or economic factors. It is questionable whether IGCC is in fact fully developed and available in comparison. NSCA is concerned that the drafts do not give any credit to the efficiency gains and economic benefits achievable by alternative technologies. These efficiency gains result in reductions in fuel usage with corresponding fuel life cycle benefits and reductions in carbon dioxide emissions.

LANDFILL TAX

A Consultation Paper

This consultation paper was issued jointly in March by HM Customs and Excise, the Department of Environment, the DOE for Northern Ireland, the Scottish and Welsh Offices, the DTI and HM Treasury.

The Government's intention to introduce a new tax on all waste disposed of to landfill sites was announced by the Chancellor of the Exchequer in the November 1994 Budget. The objectives of the tax, as outlined in the consultation paper are to

- ensure that landfill waste disposal is properly priced, which will promote greater efficiency in the waste management market and in the economy as a whole;
- apply the "polluter pays" principle and promote a more sustainable approach to waste management in which we produce less waste, and reuse or recover value from more waste.

NSCA COMMENTS

1. Relationship to the Waste Management Strategy

We agree with the two stated objectives of ensuring that landfill waste disposal is "properly priced" (which we assume to mean "reflects its full environmental costs"), and to promote a more sustainable approach to waste management. However there is an implication that the environmental costs of landfill bear less relationship to disposal costs than is the case with other disposal options such as incineration. To be consistent with the second objective, consideration might be given to an across-the-board tax on waste disposal operations. This must be balanced to give appropriate signals to minimise waste, without encouraging levels of recycling which would not be justified on lifecycle assessment grounds.

Account should also be taken of a need to increase enforcement activities both of waste regulation authorities (in respect of poorly managed and unlicensed sites), and local authorities (to discourage flytipping). At least some of the tax income could be earmarked for this purpose.

2. The Basis for the Tax

The proposal for an *ad valorem* tax raises some difficulties. High landfill prices are related to good practice by operators as well as scarcity of landfill sites. Exacerbating high gate prices could have undesirable side-effects, for instance flytipping or long distance transport of waste to cheaper sites. The arrangements for in-house and subsidised landfill are also very complicated. We recommend a tax on the basis of weight.

3. Environmental Trusts

The consultation paper asks for views on the desirability of a tax rebate to those landfill operators who make payments to trusts for "specified environmental purposes". Trusts would be non-profit distributing bodies, and in the private sector. Specified environmental purposes would include restoration of closed landfill sites (or of damage caused by such sites) where liability is unclear or the person does not have the means to do so; or research into, and development of more sustainable waste management practices.

To NSCA, this appears to be a useful proposal, with some caveats. Money should not be diverted to restore landfill sites where ownership and responsibility can be identified. On balance, more trust activity should be devoted to supporting research into recycling, recovery, and waste minimisation. Careful policing and auditing of activities must be ensured.

DIVISIONAL NEWS

East Midlands and Eastern Divisions

Since the last issue of *Clean Air* there has been one divisional meeting (1 June) and the AGM on 29 June hosted jointly by Lincoln City Council and European Gas Turbines (EGT).

The Divisional Council is extremely concerned over reports that flue gas desulphurisation plant is not being used – it appears that Ratcliffe Power Station has run for five per cent of its operating time with the FGD plant switched off; old coal-fired plant is being used in preference to FGD plant because it is cheaper. It was agreed that these concerns should be raised nationally through the appropriate committees.

It was also reported that the Nottinghamshire Community Transport Forum had recently considered the draft Nottinghamshire Public Transport Plan for 1995/96; the Plan had been influenced by the 18th Royal Commission report *Transport and the Environment* and the DOE/DOT's *Air Quality: Meeting the Challenge*. The Society's representative had expressed concern that the Plan referred to the extension of traffic calming measures, with no consideration of air quality matters; a recent Austrian study had demonstrated dramatic increases in air pollution following the introduction of road humps. The RAC had acknowledged the study and suggested that chicanes etc are preferable to road humps to minimise stop/starting of vehicles. In discussion it was pointed out that traffic calming undoubtedly improved road safety, and could reduce the number of vehicles and so not have an adverse effect on local air quality; on the other hand, traffic humps could increase road traffic noise and also increase vehicle consumption.

A small working group has been set up to look at publicity and recruitment in the Division and it is hoped that this group will work closely with any national initiatives in this area.

The Council approved in principle a seminar to be organised in late Autumn 1995; the subject chosen was "Discharges from disused coal mines" – a topic which it is hoped will also be of interest to other Divisions.

The AGM was attended by 58 members and guests and was preceded by a welcome from the Mayor of Lincoln, Cllr G. Ellis. Mr. Graham Bottomley (Director of Environmental Health, Lincoln City Council) was elected Chairman and Ken Williams OBE (Gedling BC) Vice-Chairman. The Hon. Secretary reported that the Division had had a particularly busy and active year, with a number of well-attended and interesting visits taking place. He was also sorry to report the death during the year of Cllr Frank Holland who had been a very long-standing and active member of the Division.

Following the AGM excellent presentations were given by European Gas Turbines on policies for environmental protection, reductions in local noise, and NOx in development of gas turbines. A further presentation was given by Delta Simons Environmental Consultants on VOC emissions and controls. Following a buffet lunch, participants had an opportunity to visit EGT manufacturing, testing and packaging sites. The Division's Chairman thanked EGT for an enjoyable and informative meeting, congratulating them for their efforts in ensuring the success of the meeting.

North West Division

The Extraordinary meeting of the Division passed a resolution to retain its AGM in September and to consider the financial report at a regular date in April. This effectively regulates the Division's management of funds and brings them in line with the Society's financial year end. Since the AGM is to remain in September, it was also agreed that the Chairman of the Division, although elected in September would not take up office until after the NSCA's annual conference.

The Divisional Council meeting, following the Extraordinary meeting, revolved around air quality assessment, monitoring systems, urban pollution determination and transport initiatives – all issues which form the backbone of NSCA work under the sustainability umbrella. After a comprehensive presentation by Envirotech on air quality monitoring and real time analysis, discussion centred around emission inventory assessment and the "tools for the job". Members made the point that the evolution of AQM will not only affect all local authorities in respect of monitoring and planning aspects, but will also have knock-on effects for industry and commerce: they will be required to meet lower emission levels which will eventually be quantifiable through the emission inventory assessments required under the new legislation. The presentation proved to be a successful catalyst for the exchange of ideas and was undertaken by a company who subscribe to the NSCA.

No doubt along with other Divisions new venues for meetings are sometimes difficult to arrange. The Divisional Council are mindful that members of the Division who do not attend Council meetings may well have some suggestions for interesting venues which would be willing to facilitate a future meeting/activity. The Secretary is planning to make

the initial arrangements for next year's programme prior to the September AGM. All members of the Division are asked to contact the Secretary with any suggestions for venues.

South East Division

The 40th AGM of the Division was held in May at the British Coal Corporation in London. Mr. Paul Cooney was re-elected Chairman, Mr. F. John Smith, Deputy Chairman and Mr. Joe Beagle, Hon. Secretary. Mr. George Vulkan was elected Hon. Auditor, replacing Mr. Brian Nagle who stood down having held the post for the past two decades. A vote of thanks was passed to Mr. Nagle who has been associated with the Division for nearly 30 years.

Following the AGM Mr. L.D. Jones, Regional Manager of the NRA Thames Region addressed the meeting on the work of the NRA and the future in the context of the Environment Agency. He said that the Thames is now the cleanest major waterway in Europe, supporting 120 different species of fish, including salmon (although the latter have not yet spawned); the Thames serves 12 million people and 58% of all the rainfall is used for water supplies. Last year the Region's technical officers made 3,000 visits in the course of their pollution prevention work; on average there are 1,500 pollution incidents each year and up to 100 prosecutions. Nitrate levels are strictly controlled and give no cause for immediate concern. Mr. Jones concluded by noting that the new Environment Agency will have a duty to protect the environment through a policy of sustainability, whilst maintaining the highest professional standards. He was confident that the three elements comprising the Agency – HMIP, NRA and waste regulation authorities - would maintain the high standards achieved by the NRA in protecting water supplies from pollution.

There has been concern in the Division that powers contained in the new *Deregulation and Contracting Out Act 1994* would be used to lift the London Nighttime and Weekend Lorry Ban. However, Mr. Steven Norris, Minister for Local Government and Road Safety, has now written to the Hon. Secretary saying that any amending order will at least be equal to, or better than, the current arrangements, and that there will be full consultation prior to any changes.

The Division is also concerned about the rising numbers of children and adults suffering from respiratory illnesses, and the differences in perception of its cause; on the one hand, the public and media blame vehicle pollution, whereas many medical and environmental health experts attribute other causal factors which may trigger off allergies that aggravate the respiratory tract. The Division, in conjunction with the South East Institute of Public Health is therefore proposing to hold a seminar to look at all aspects of the issue.

South West Division

Inbetween its regular quarterly meetings, the Division organised a half-day workshop in May, hosted by Woodspring District Council; it was attended by members from both the South West and South and Mid Wales Divisions.

Two issues, namely the effectiveness of neighbourhood noise control and the air quality challenge, were introduced and summarised by Keith Horton and Duncan Laxen respectively. In discussion, the overriding concern of many was the need for Central Government to provide sufficient resources to ensure a real and effective response to both issues. A resumé of the workshop can be obtained from the Hon. Secretary, Peter Gendle on 01934 634839.

Open Divisional meetings for 1995 include:

14 September: (Following the AGM), joint seminar with the CIEH on Transport and Energy. Venue: Bath City Council.

14 December: Dioxins and incineration. Venue: Taunton Deane Borough Council.

Further details of both meetings from Peter Gendle, as above.

NSCA POLICY DOCUMENTS AND REPLIES TO CONSULTATION DOCUMENTS April – June 1995

Please contact Sally May at NSCA, 136 North Street, Brighton BN1 1RG (Fax: 01273 735802) if you would like a copy of any particular document not published in *Clean Air*. The date following each entry is the date of the NSCA document/letter.

Amendment of *Statutory Nuisance (Appeals) Regulations 1990* (DOE). 12 April.

BPEO Assessment Principles for IPC (HMIP). 19 April.

Environment Bill – selected Committee Stage Amendments (NSCA commentary). 24 April.

Revisions to IPR Notes relating to fuel production and combustion processes (HMIP). 18 May. See this issue of *Clean Air*.

Cemfuel: Environment Committee Enquiry into Burning of Secondary Liquid Fuels in Cement Kilns. 22 May. See this issue of *Clean Air*.

Landfill Tax – a consultation paper (HM Customs & Excise, DOE et al). 9 June. See this issue of *Clean Air*.

Review of Effectiveness of Neighbour Noise Controls (DOE). 28 June. See this issue of *Clean Air*.

REPORTS

SMOKE CONTROL PROGRAMMES 1994/95

During 1994/95 grants totalling £1.9 million were awarded to three local authorities. Currently 13 local authorities are completing smoke control programmes and a large number have either suspended programmes or delayed setting a target. This implies that there is still work to be done. However, as Government grants towards the costs of implementing smoke control programmes are not available for Orders made after 31 March 1995 it is likely that many of these will remain incomplete.

In view of this there is likely to be little further progress in implementation of smoke control programmes. NSCA is therefore reviewing the validity of continuing to monitor progress in this area.

Smoke Control Areas

The following table lists the local authorities in the United Kingdom who currently enforce Smoke Control Orders. The information has been compiled directly from returns from local authorities. It can be assumed that any authority not listed does not have a smoke control programme.

The table shows target date for completion of the smoke control progamme; the final area to be covered in hectares; the percentage area of the authority currently covered by Smoke Control Orders and the number of premises. It must be noted that some areas cover large rural districts; thus, although the percentage area covered in these authorities may be low, the proportion of premises covered is high and smoke control comprehensive.

The figures are for the position on 31 March 1995.

The United Kingdom divisions, issued by the Department of the Environment are as follows:

East Anglia	Norfolk, Suffolk
East Midlands	Derbyshire, Leicestershire, Lincolnshire
Greater London	
North West	Cheshire, Greater Manchester, Lancashire, Merseyside
Northern	Cleveland, Cumbria, Durham, Northumberland, Tyne and Wear
Northern Ireland	
Scotland	
South East	Bedfordshire, Berkshire, Buckinghamshire, East Sussex, Essex, Hampshire, Hertfordshire, Kent, Oxfordshire, Surrey, West Sussex

South West	Avon, Cornwall, Devon, Dorset, Gloucestershire, Somerset, Wiltshire
Wales	Clwyd, Dyfed, Gwent, Gwynedd, Mid-Glamorgan
West Midlands	Hereford & Worcester, Salop, Staffordshire, Warwickshire West Midlands
Yorkshire & Humberside	Humberside, North Yorkshire, South Yorkshire, West Yorkshire

Key

Comp - completed

n/k - not known

Susp - suspended

Clld - programme cancelled

x - no return received; previously returned figures used.

AUTHORITY	TARGET DATE	FINAL AREA	% OF TOTAL	PREMISES
EAST ANGLIA				
Cambridge CC	Susp	n/k	14	n/k
Kings Lynn & W N BC	n/k	n/k	0.2	4474
Norwich CC	Susp	3907	16	3595
Peterborough CC	n/k	3115.45	9.34	40127
EAST MIDLANDS				
Amber Valley BC	n/k	19300	6	8519
Ashfield CC	Comp 1992	11010	100	48390
Bassetlaw DC	1993	7524.1	11.8	31980
Blaby DC	Comp	4692	36	23328
Bolsover DC	1993	16138	100	32501
Broxtowe BC	Comp	6017	100	37468
Chesterfield BC	Comp 1991	16264	100	39600
Corby DC	Comp	1057	13.2	11860
Derby CC	Comp 1986	19282	100	90233
Erewash BC	1992	2005.47	18.33	21462
Gedling BC	1994	2773.5	23	41600
High Peak BC	Comp 1986	1666	3	14148
Leicester CC	Comp	7337	100	113000
Lincoln CC	Comp 1989	3571	100	39777
Mansfield DC	1993	7692	100	46257
NE Derbyshire DC	n/k	68484	30	30543
Newark & Sherwood DC	Comp 1991	3153	4	11702
North Kesteven DC	Comp	121	0.13	983
Northampton BC	Susp	n/k	40	22800
Nottingham CC	Comp 1991 x	7431.9	100	134085
Oadby & Wigston BC	n/k	59	n/k	18968
Rushcliffe BC	Comp 1983	1308	3.1	11569
South Kesteven DC	Comp	1550	1.62	16500
West Lindsey DC	Comp 1992	28	0.02	1

AUTHORITY	TARGET DATE	FINAL AREA	% OF TOTAL	PREMISES
LONDON BOROUGHS				
Barking & Dagenham	Comp 1985	8886	100	70118
Barnet	Comp x	n/k	99	134819
Bexley	Comp	2603	100	89886
Brent	Comp 1984	4421	100	109245
Bromley	Comp 1979	29600	79	137000
Camden	Comp 1968 x	5365	100	88214
Corp of London	Comp	n/a	100	12761
Croydon	Susp	21395	62	106000
Ealing	Comp	5550	100	115000
Enfield	Comp 1973	8118	100	110000
Greenwich	Comp 1972	5017	100	94498
Hackney	Comp x	4814	100	n/k
Hammersmith	Comp 1967	3988	100	73000
Haringey	Comp x	3031	100	93000
Harrow	Comp 1975	n/k	100	all
Havering	Comp 1979	12000	100	90000
Hillingdon	Comp 1980	10877958	100	96429
Hounslow	Comp 1972 x	14460	100	89614
Islington	Comp 1969 x	9091	100	65000
Kensington & Chelsea	Comp x	2950	100	25288
Kingston u Thames	Comp 1980	1496	100	55738
Lambeth	Comp 1978	2724	100	116000
Merton	Comp 1977	3796	100	all
Newham	n/k	3637	100	90000
Redbridge	Comp 1974	5650	100	78000
Richmond	Comp	12866	100	88914
Southwark	Comp 1988	2886	100	97000
Sutton	Comp	4343	100	67730
Tower Hamlets	Comp x	1973	100	n/k
Waltham Forest	Comp 1985	3967	100	90000
Wandsworth	Comp 1980	3586	100	121250
Westminster	Comp 1970	2120	100	116300
NORTH WEST				
Blackburn BC	Comp 1986 x	5278	38.4	48271
Bolton MBC	Comp 1994	34572	100	105077
Burnley BC	Comp 1980	9592	82	42050
Bury MBC	1994 x	9916.63	78.78	58292
Chorley BC	n/k	1622.42	2.2	3186
Crewe & Nantwich BC	Comp 1993 x	994.3	2.3	12214
Ellesmere Port BC	Comp 1982	1577	21	32114
Halton BC	Susp x	n/k	90	39933
Hyndburn BC	Comp 1980	16611	92	37976
Knowsley MBC	Susp	2580	23	20837
Lancaster CC	n/k x	n/k	5.67	9478
Liverpool CC	Comp 1992	11258	100	222629
Macclesfield BC	Comp	123	0.2	2635
Manchester CC	Comp 1985 x	11624	100	214000
Oldham MBC	1993 x	21361	60.7	102788
Pendle BC	Comp	14964	36	29500
Preston BC	Comp 1985	8347	26	48675
Ribble Valley BC	n/k	n/k	2	848
Rochdale MBC	Comp 1989 x	30724	70	78222

AUTHORITY	TARGET DATE	FINAL AREA	% OF TOTAL	PREMISES
Rossendale BC	Comp	12600	91	26810
Salford CC	Comp 1978	23942	100	90279
Sefton MBC	n/k x	14742	5.7	2587
South Ribble BC	1994 x	11307	70	39427
St Helens MBC	1993 x	12327	94.61	69527
Stockport MBC	n/k	31147	79	116300
Tameside MBC	Comp 1980	10360	100	123801
Trafford MBC	n/k	n/k	100	106000
Vale Royal BC	n/k x	2777	7.2	11236
Warrington BC	Comp 1979	18059	95	75900
West Lancashire DC	Susp	n/k	20	14236
Wigan MBC	n/k x	n/k	56	73255
Wirral MBC	Comp 1995	13178	85	120211
NORTHERN				
Allerdale DC	1995 x	125729	95	41596
Alnwick DC	n/k	n/k	0.004	76
Blyth Valley BC	1992	7000	100	31556
Carlisle CC	Susp	898	0.3	4500
Castle Morpeth BC	1998	449	1.65	6155
Copeland BC	Susp	845	1.2	7876
Darlington BC	Comp 1987	6469	13.1	39968
Derwentside DC	n/k	n/k	0.69	3974
Durham CC	1996	18903	75	30911
Easington DC	19930	3302	84	31571
Gateshead MBC	1992	14163	100	92000
Hartlepool BC	Comp 1982	3672	39	34416
Langbaurgh BC	1995	5854	24.4	55000
Middlesbrough BC	Comp 1979	5427	91	56000
Newcastle-u-Tyne MBC	n/k x	11187	100	119923
North Tyneside MBC	Comp	8383	100	72000
Sedgefield DC	None	189	8.6	6000
South Derbyshire DC	n/k	694.74	2	5500
South Tyneside MBC	Comp x	6100	93	68000
Stockton-on-Tees BC	Comp x	16227	34	60000
Sunderland CC	1995	13958	100	131800
Wansbeck DC	1993	6630	100	29736
NORTHERN IRELAND				
Antrim BC	Comp 1976 x	740	100	7192
Ards BC	None	n/k	0.05	823
Armagh DC	n/k x	n/k	5	96
Ballymena BC	Susp x	n/k	0.9	890
Belfast CC	1996	7101.49	82.45	108935
Castlereagh BC	n/k	2646	33.2	20370
Coleraine BC	n/k	n/k	0.07	410
Down DC	n/k	n/k	0.003	n/k
Larne BC	1998	964	0.46	290
Newry & Mourne DC	1997 x	270	0.0008	972
Newtonabbey DC	n/k x	n/k	5	7084
North Down BC	n/k	176	5	1100

AUTHORITY	TARGET DATE	FINAL AREA	% OF TOTAL	PREMISES
SCOTLAND				
Bearsden & Milngavie	n/k	n/k	95	14900
Clackmannan DC	n/k	16100	3.9	3900
Clydebank DC	Comp 1980	9330 100	18629	
Cumbernauld & Kilsyth	n/k	n/k	1.70	2080
Cunninghame DC	1995	3860	4	27000
Dumbarton DC	2005	11787	6	16957
Dundee CC	n/k	23504	40	69778
Dunfermline DC	1995	774	2.57	5626
East Kilbride DC	Comp	5471	8	26790
Edinburgh DC	1995	23877	52	105000
Ettrick & Lauderdale	n/k	715	0.07	7002
Falkirk DC	1996	20000	26	45500
Glasgow CC	Comp 1992	20266	100	329497
Hamilton DC	n/k	n/k	12.8	16844
Inverclyde DC	n/k	n/k	23	9290
Kilmarnock & Loudoun	n/k	41	<1	578
Kirkcaldy DC	1996	2577	9.5	17300
Kyle & Carrick DC	Comp	243	0.04	156
Monklands DC	Comp 1995	40000	100	30500
Motherwell DC	n/k	n/k	2	6518
Nithsdale DC	None	4000	<1	7865
Perth & Kinross DC	n/k x	0	0	40500
Renfrew DC	Clld	21986	29	71500
Roxburgh DC	n/k	n/k	0.1	1900
Stirling DC	n/k	153	<1	2050
Strathkelvin DC	n/k	160000	12	7000
West Lothian DC	Comp	2700	6	16000
SOUTH EAST				
Aylesbury Vale DC	Susp x	3594	>1	5320
Basildon DC	n/k	n/k	16.5	21682
Bedford BC	Comp 1987	2200	4	37160
Bracknell Forest BC	Comp	3811	14	35000
Brentwood DC	n/k x	n/k	40	2856
Brighton BC	Susp	596	10	24392
Broxbourne BC	Comp	n/k	100	32143
Canterbury CC	n/k	31246	0.34	2865
Crawley BC	n/k	11520	37.9	38243
Dacorum BC	Comp x	1509	7	15000
Dartford BC	Comp	17267	n/k	31035
Elmbridge BC	Comp	0.4	n/k	50
Epping Forest DC	n/k	600	1.7	2463
Fareham BC	2000	7413	n/k	n/k
Gillingham BC	Comp	3240	100	37183
Gravesham BC	Comp 1985	1834	18	25800
Guildford BC	Comp 1985	2428	9	10517
Harlow DC	Comp 1994	2905	80	30000
Hertsmere DC	n/k	9397	10	7913
Luton BC	Comp 1979	4336	100	85000
Milton Keynes BC	Susp x	3180	10.25	33300
North Herts DC	Comp	543	1.4	5000
Oxford CC	Susp	620	61	3500
Portsmouth CC	Susp	4027	16.8	19039

AUTHORITY	TARGET DATE	FINAL AREA	% OF TOTAL	PREMISES
Reading BC	Susp x	3995	62	45000
Rochester u Medway CC	n/k	n/k	16	19974
Sevenoaks DC	Comp 1969	553	1.49	7344
Slough BC	Comp 1988	2743	100	39796
South Buckingham DC	n/k	n/k	<1	122
South Oxfordshire DC	n/k x	n/k	0.3	400
Southampton CC	Comp 1981	1750	32.6	27551
Spelthorne BC	None x	5617	85	31834
Stevenage BC	Comp 1982	n/k	97	n/k
Thurrock BC	None	n/k	22.23	22800
Watford BC	Comp 1979	2145	100	35019
Windsor & Maidenhead DC	Comp 1982	336	6	2655
Wycombe DC	Comp	1546	5	21500
SOUTH WEST				
Bath CC	1994	n/k	100	38000
Bristol CC	Comp 1988 x	26516	100	155340
Cheltenham BC	Susp	4680	35.15	16235
Exeter CC	n/k	11660	60	19000
Kingswood BC	n/k	n/k	0.1	130
Northavon DC	Comp 1990	2456	5.32	12885
WALES				
Alyn & Deeside DC	n/k	n/k	0.1	449
Delyn DC	Comp 1979	233.5	0.7	941
Newport BC	N/K	27.10	0.14	654
Swansea CC	Comp 1989	249	0.3	2710
Wrexham Maelor	Susp	11.21	2.4	10390
WEST MIDLANDS				
Birmingham CC	1996 x	n/k	n/k	n/k
Cannock Chase DC	1998	7892	23.9	14607
Coventry MBC	Comp	10000	95	131895
Dudley MBC	Comp 1989	9794	100	156000
East Staffordshire DC	Comp 1995	1912	4.902	17131
Litchfield DC	1994	3574	11	21205
Newcastle u Lyme BC	1995	4489	21	40152
North Shropshire DC	Susp	530	0.3	1965
North Warwickshire BC	1992	4595	16	16764
Nuneaton & Bedworth BC	Comp 1994	6272	79	41062
Rugby BC	Comp 1979	7010	9	23301
Sandwell MBC	Susp	8608	31	34446
Shrewsbury & Atcham BC	n/k	n/k	0.7	3350
Solihull MBC	1993	5098	28.5	57618
South Staffs DC	Susp	6400	5.1	3066
Staffs Moorlands DC	1995 x	2071	3.5	17429
Stoke-on-Trent CC	1992	9287	100	104151
Tamworth BC	1995 x	1100	60	43877
Walsall MBC	Clld	10630	81.4	91000
Warwick DC	Comp	2737	10	36003
Wolverhampton MBC	None	6892	76.95	67775
Worcester CC	1992	481	100	32778
Wrekin C	Susp	19311	13	19966
Wyre Forest DC	n/k	n/k	1.32	6867

AUTHORITY	TARGET DATE	FINAL AREA	% OF TOTAL	PREMISES
YORKSHIRE AND HUMBERSIDE				
Barnsley MBC	1995	32863	100	98495
Bradford MBC	n/k	91444	56	180106
Calderdale MBC	Comp	16443	45	103207
Chester Le Street DC	1997	5500	31	15656
Craven DC	n/k	n/k	10	9500
Doncaster MBC	Comp 1994	58276	100	105000
Glanford BC	n/k	58061	3	5350
Harrogate BC	Susp	529.600	1.1	21547
Hull CC	Comp 1992	7101	100	121066
Kirklees MBC	Comp	40910	100	172625
Leeds CC	Susp	56027	54.61	223463
Rotherham MBC	Comp	28280	100	11970
Ryedale DC	1995	910.31	0.48	13506
Scunthorpe BC	Comp 1981 x	3376.48	100	27200
Selby DC	Comp 1990	3097	4.3	11285
Sheffield CC	Comp 1981	25553	100	230000
Wakefield MBC	1994	35120	100	35120

IMPROVING AIR QUALITY IN THE UNITED KINGDOM

R.G. Derwent
Atmospheric Processes Research Branch
Meteorological Office

1 INTRODUCTION

Until recently, strategies to improve ambient air quality in the United Kingdom have been entirely technology-based. The 1990 Environment White Paper, *This Common Inheritance* (HMSO 1990), laid the foundations for a new approach to the formulation of air quality standards – an effects-based approach. The essence of effects-based strategies is to assess the impact of air pollution on human health and the environment, to set standards for specific pollutants and then to establish a comprehensive programme designed to secure these standards (DOE 1994).

An effects-based approach does not dispense with technology-based controls. These are the only known ways of tackling individual sources of pollutants. It simply provides an effective framework by which the environmental gains from potential regulatory controls can be measured and judged.

In this paper, the environmental science underpinning the application of an effects-based approach to ozone, benzene, carbon monoxide and 1,3-butadiene is reviewed. The aim is not to present a prescriptive strategy; this is for agreement between the various regulatory bodies and the representatives of those industries and activities to be regulated. The aim here is to identify whether the necessary elements of effects-based strategies can be adequately defined for the necessary policy development.

2 IMPROVING OZONE AIR QUALITY IN THE UNITED KINGDOM

2.1 Introduction to Ozone

For the last two decades, ozone has been regarded as a serious air pollutant in the UK, because of its aggressive and irritant nature. Of the many common air pollutants covered by internationally-accepted environmental health criteria documents (WHO 1987), ozone is the only widespread pollutant for which ambient concentrations in the UK regularly exceed published air quality guidelines.

2.2 Ozone Air Quality: The Current Situation

Much of the detail concerning the curent situation with respect to ozone air quality in the UK has recently been reviewed by the UK Photochemical Oxidants Review Group (UK PORG 1993). Photochemical air pollution is not restricted just to the UK but is a widespread phenomenon in many other countries of north west Europe.

The Expert Panel on Air Quality Standards (EPAQS) has recently recommended an air quality standard (AQS) for ozone of 50 ppb, maximum 8-hourly running mean concentration (EPAQS 1994). This is a human-health based air quality standard which has been set using a lowest observable effects level and an element of protection for the more vulnerable members of the general public. This air quality standard defines the target for which ozone air quality policies should seek to aim. As a parallel exercise, critical levels

are being developed for the impacts of ozone on semi-natural ecosystems, crops, plants and trees (Fuhrer and Achermann 1994). Critical levels for ozone and air quality standards both represent appropriate targets for which air quality policies should aim. Here attention is limited solely to the achievement of the human health-based air quality standard set by EPAQS.

The EPAQS ozone air quality standard has been exceeded in at least one year at every site for which ozone measurements are available in the UK PORG ozone database (UK PORG 1993). Exceedances of the EPAQS ozone AQS are least likely in the Highlands of Scotland and Northern Ireland with increasing exceedance across England and Wales moving southwards and to a slightly lesser extent eastwards, see Table 1. The elevated regions of the Pennines, Welsh uplands, Dartmoor and Exmoor stand out with dramatically increased number of hours above the EPAQS ozone AQS, as does the south east of England closest to the European continent.

This spatial pattern of EPAQS ozone AQS exceedance reflects:

* the more frequent occurrence of summertime anticyclonic sunny weather in the south and east,
* the importance of long range transport from the more dense precursor emission areas in the low countries compared with the regions which border the low countries to their north or south, and
* the importance of altitude and of local nocturnal atmospheric stability on the diurnal pattern of photochemical ozone in rural locations.

Two factors can therefore be quantified from the available monitoring data concerning the exceedance of the EPAQS ozone AQS namely, frequency of exceedance (see Table 1) and extent of exceedance (see Table 2). Both of these factors show significant year-on-year variability which needs to be taken into account in deriving policy consequences from AQS exceedance data.

2.3 Modelling Photochemical Ozone Formation

In north west Europe in general and in the UK in particular, little ozone precursor monitoring has been carried out during the two decades since photochemical ozone formation and its long range transport were first detected. As a consequence, observational-based approaches to the rational design of cost-effective ozone control strategies have not been made available to policy makers. Instead reliance has been placed in a range of sophisticated long range transport models which describe the relationship between ozone exposure levels and the emissions of its main precursor gases, oxides of nitrogen and hydrocarbons.

These models, their formulation and application to regional scale ozone formation in Europe, have been reviewed elsewhere (Nordic Council of Ministers 1991; Murlis and Derwent 1993; Iversen 1991). The main modelling approaches in Europe (Heymann, Trukenmuller and Friedrich 1993) are identified as follows:

* EMEP model, a single level photochemical trajectory model (Simpson and Hov 1990);
* LOTOS model, a three-level Eulerian grid model (Builtjes 1992);

* EURAD model, a nine level Eulerian grid model (Hass 1991);
* UK Photochemical Trajectory model, a single level Lagrangian trajectory model (Derwent and Jenkin 1991).

In the UK Photochemical Trajectory model, greatest attention is given to the representation of hydrocarbon emissions and chemistry and this distinguishes this approach from the three other modelling approaches identified above.

Photochemical models can be used to define those areas of Europe where ozone formation is limited by the availablity of one or other of the two main ozone precursors: hydrocarbons and oxides of nitrogen (Derwent and Davies 1994). The areas of north west Europe which are likely to be hydrocarbon limited can be delineated using a spatially-disaggregated emission inventory such as the 1985 CORINAIR NO_x inventory (CEC 1991). Ozone formation in these hydrocarbon limited regions is controlled by the product of two terms:

* the number of NO_x molecules oxidised to PAN and nitric acid, and
* the number of ozone molecules produced per NO_x molecule oxidised.

In the hydrocarbon limited region, the number of ozone molecules produced per NO_x molecule oxidised increases with hydrocarbon concentration levels and decreases with NO_x concentration levels, hence its name. Hydrocarbon limited regions are found in the most densely populated and industrialised regions of north west Europe and as isolated industrial centres on the Mediterranean coast. Much of the densely populated areas of south and east British Isles are hydrocarbon limited regions. In these regions, hydrocarbon emission controls, followed by NO_x emission controls or some combination of both, are usually the most efficient at reducing ozone exposure levels (Derwent and Davies 1994).

In the rest of Europe, the amount of NO_x available is limiting and ozone levels are determined by the relative efficiency of long range ozone transport from the hydrocarbon limited regions and ozone dry deposition. In these regions, local hydrocarbon emission control is usually ineffective whilst NO_x control is highly effective (Derwent and Davies 1994).

Table 2 contains the peak ozone concentrations calculated using the UK Photochemical Trajectory model, for the southern British Isles in the base case run for an air parcel trajectory which starts off in central Europe and moves in a westerly direction over Germany, Netherlands, the North Sea, England, Wales and the Republic of Ireland in a period of six days (Derwent and Jenkin 1991). This idealised trajectory is meant to represent the worst case meteorological situation for southern England based on an analysis of a whole range of ozone episodes in north west Europe over the period up until the middle 1980s (Builtjes 1987).

The observed and model calculated peak ozone concentrations are well within range of each other. Whilst this level of agreement is useful for policy development in that model and observation appear to be in reasonable agreement, this does not imply that the model is necessarily a valid representation of reality. Some of the issues surrounding the validation of the UK Photochemical Trajectory model are discussed in detail elsewhere (Derwent 1989; 1990).

2.4 Analysis of Policy Options for Ozone Air Quality in the UK

The application of simple roll-back to the air quality data in Table 2 would indicate a control requirement of about 85% for hydrocarbons to meet the EPAQS ozone AQS at the site with the greatest exceedance in the most polluted year. Current policies are expected to deliver a substantially smaller percentage reduction by the year 2000, in comparison. It is extremely important to know whether emission control should be implemented evenly across all hydrocarbon precursor emission source categories or whether targetting the emissions controls would be more cost-effective. There is also the question of the relative merits of NO_x and hydrocarbon controls. For this level of sophistication, the roll-back approach is wholly inadequate and reliance has to be placed on photochemical models (Nordic Council of Ministers 1991).

The approach adopted in this study of policy options for ozone air quality in the UK entails an analysis of the impact of present policies on the future emissions of the main ozone precursor gases, hydrocarbons and the oxides of nitrogen. Computer modelling studies are then required to relate the future precursor emissions to ozone air quality. Account also needs to be taken of the impact of present policies on a number of other trace gases that exert an influence on photochemical ozone formation. These other trace gases include carbon monoxide, sulphur dioxide and methane.

Current policies for hydrocarbon emission controls in the UK, which are outlined in the DOE Consultation Paper on VOC emissions (DOE 1993; Passant 1993), promise a reduction of 36% in hydrocarbon emissions by 1999 on 1988 levels. Current policies for NO_x control are scenario dependent and promise between 15-30% reduction in total NO_x emissions by the year 2000 relative to 1990 levels (Eggleston 1992). The corresponding figures for carbon monoxide and sulphur dioxide are 36% and 32-46%, respectively, for the year 2000, also relative to their 1990 levels (Eggleston 1992).

Table 3 summarises the assessment of the impact of current policies on ozone concentrations, relative to the base case model, in the year 2000 for the southern British Isles using the UK Photochemical Trajectory model. A reduction in peak ozone concentrations amounting to about 16-43 ppb is anticipated by the year 2000 on current policies. Though welcome, this reduction in peak ozone concentrations is unlikely to be large enough to ensure that, in the future, the EPAQS ozone AQS will not be exceeded somewhere in the UK, during most summers. On a percentage basis, peak ozone concentrations across the southern British Isles are expected to decrease by between 20 and 34% relative to the base case.

On the basis of Tables 2 and 3, it is judged likely that the EPAQS ozone AQS will not be exceeded during the majority of summers by the year 2000 and thereafter, at the following sites: Strath Vaich and Lough Navar. There is a reasonable probability that in most summers, the EPAQS ozone AQS will not be exceeded during most summers by the year 2000 at the following additional sites: Glazebury, Bush, Eskdalemuir, Wharley Croft and High Muffles. At the remaining sites in Wales, the midlands, the south east and the south west of England, exceedances of the EPAQS ozone AQS are still considered likely in most summers on current policies, into the foreseeable future.

The policy measures and assumptions concerning hydrocarbon, NO_x, SO_2 and CO emissions, which have been taken into account in the consideration of current policies, have included:

* official forecasts of energy use, electricity demand and vehicle kilometres (high and low growth estimates);
* fitting of low-NO_x burners to power stations, closed-loop three-way catalysts to petrol cars, emission controls to HGVs, evaporative emission controls to petrol cars;
* a certain amount of three-way catalyst deterioration and some penetration of diesel cars into the private car fleet.

Some simplifying assumptions have had to be made, however, in the above analysis, including:

* a similar across-the-board decline in precursor emissions is anticipated throughout Europe as has been assumed for the UK;
* that there are no major changes in the spatial patterns of precursor emissions;
* that there are no major changes in the hydrocarbon speciation, particularly in the United Kingdom;
* that there are no major differences across the UK in the major sources responsible for photochemical ozone formation.

Much further research is required to improve the description of hydrocarbon emissions and chemistry in the model and to extend the spatial coverage of the photochemical trajectory model to include the entire British Isles. Of some likely importance is the paucity of information in the current hydrocarbon emission projections concerning any changes both in the magnitude of total emissions and of their speciation in response to pollution controls (Passant 1993). It is likely that the reactivity of the hydrocarbon emissions will decline in response to pollution controls, through solvent substitution, for example. For this reason alone, it is likely that the impacts of stationary hydrocarbon emission controls have been grossly underestimated in Table 3.

2.5 Additional Policy Measures on Ozone

Studies with the UK Photochemical Trajectory model have suggested that to meet the EPAQS ozone AQS in the south and east of England, hydrocarbon emission reductions of about 85% would be required or somewhat greater than 95% reductions in NO_x emissions. Such emission reductions are well beyond any contemplated in current policies. Nevertheless, it is instructive to see what the major sources of ozone precursors are likely to be in the emission inventories for the year 2000, on current policies. Additional control measures on these major sources could contribute significantly towards the goal of meeting the EPAQS ozone AQS at some date in the future.

Consideration of the emission inventories in the year 2000 and the results presented in Table 3, points to there being significant prospects in further reduction in NO_x emissions. Small reductions in NO_x emissions often appear counter-productive because, more often than not, ozone increases are anticipated. Further increased NO_x reductions, however, bring substantial benefits, particularly in remote regions where long range transport dominates over local production. The impression is given in Table 3 that the impact of the anticipated NO_x emissions controls on peak ozone concentrations is likely to be small and to offset some of the benefits of hydrocarbon emission controls. This situation would be redressed by further action to reduce NO_x emissions.

Some potential measures to reduce NO_x emissions, beyond the measures anticipated in the NO_x emission projections in Table 3, include:

* Exhaust gas recirculation on HGVs;
* Compressed natural gas on buses and HGVs;
* Low technology SNCR, advanced SNCR and SCR on large combustion plant.

The detailed study of the forecast reductions in UK hydrocarbon emissions (Passant 1993) can be used to identify those sectors which, because their anticipated reduction in emissions up to 1999 is below the overall 36% reduction, will contribute proportionately more in the future compared with the present. These sectors include: pharmaceuticals, aerosols, non-aerosol products, agrochemicals, oil production, oil distribution, other oil industry emissions, baking, alcoholic drink production, landfills, waste incineration, sewage treatment and animal husbandry. There may be scope to bring about some further reduction in hydrocarbon emissions from these sectors.

The UK VOC emission strategy document (DOE 1993) did not consider the following additional control measures:

* Reductions in the RVP of leaded and unleaded petrol;
* complete implementation of Stage I and II petrol vapour recovery systems throughout the petrol distribution and storage system;
* fitting large canisters to petrol cars; and
* more aggressive implementation of control measures and the more rapid phase-out of reactive solvents, solvent-based paints and household products.

2.6 Conclusions on Ozone

Without further stringent policy development both in the UK and in the rest of Europe, addressing both NO_x and hydrocarbon emissions reductions, it can be said with some confidence that episodic peak ozone concentrations in the southern British Isles will continue to exceed the EPAQS ozone AQS for the foreseeable future. The impact of present policies on the exceedance of the EPAQS AQS for ozone at various different type of sites and locations is illustrated in Figure 1.

3 IMPROVING BENZENE AIR QUALITY IN THE UNITED KINGDOM

3.1 Introduction

Benzene is an organic compound that is widely distributed in the ambient atmosphere. Almost all of the benzene found at ground level in the northern hemisphere is likely to have originated from human activities, in particular, the combustion of petroleum products by motor vehicle engines. Benzene is classed as a human genotoxic carcinogen and workers exposed to high concentrations have run the small but definite risk of developing certain types of leukaemia. Sources, effects and concentrations of benzene in the UK are reviewed comprehensively elsewhere (Duggan, Hamilton and Revitt 1993).

3.2 Benzene Air Quality: The Current Situation

3.2.1 Current Air Quality

Until recently there were hardly any measurements of benzene at all for the UK. The first reported measurements were made during the summer of 1982 in central London, rural Berkshire and by the side of the M1 motorway in Bedfordshire (Clark et al. 1984). The first reported long term UK benzene measurements were for rural locations (UK PORG 1993):

* Harwell, Oxfordshire, 1986-1990, 0.81 ppb;
* Great Dun Fell, Cumbria, 1989-1991, 0.34 ppb;
* West Beckham, Norfolk, 1989-1991, 0.73 ppb.

These early measurements used sporadic bottle samples, followed by gas chromatographic analysis.

Continuous hourly urban measurements using cryotrapping sampling with gas chromatographic detection began in July 1991 and continued for one year at a roadside site in Exhibition Road, London (Field et al. 1994). The long term annual mean benzene concentrations reported for Exhibition Road, London during 1991-92 were 4.6 and 4.1 ppb, taking weekdays and all days, respectively.

The Exhibition Road, London benzene measurements, which are described in detail elsewhere (Derwent et al. 1995), confirmed that motor vehicle traffic movements in Exhibition Road and in the wider area of central London, accounted for the greater part of the benzene concentrations found at that roadside location. The benzene emissions from motor traffic required to explain the observed benzene concentrations amounted to about 90-150 mg/km travelled, in excellent agreement with the on-board vehicle measurements of 116-196 mg/km travelled (Bailey et al 1990).

Table 4 presents the available benzene measurements for urban background sites up to the present day (Dollard et al 1994b), based on a network of continuous, automatic cryotrapping gas chromatographs fitted with telemetric data collection and analysis. Generally speaking, the urban background benzene concentrations reported in Table 4 are considered typical of the urban exposure levels of a large section of the general population. Mean benzene concentrations are comparable at about 2.1 ppb for Birmingham and Cardiff, but somewhat higher than those reported for London Bloomsbury, 1.9 ppb, Belfast, 1.7 ppb and Middlesbrough 1.3 ppb. Concentrations appear lowest at the London, Eltham and Edinburgh sites. The urban background benzene concentrations reported for Birmingham and Cardiff are about a factor of two lower than those reported for the urban roadside site in Exhibition Road, London.

Continuous hourly benzene concentration measurements have yet to be made in the UK at the kerbside of the most heavily-trafficked roads. Although the Exhibition Road, London measurements of Derwent et al (1995) do not come into this category, they can be used to estimate such concentrations in conjunction with the Cromwell Road, London kerbside NO_x and carbon monoxide concentrations. On this basis, it is estimated that mean benzene concentrations at the kerbside adjacent to heavily trafficked roads may lie in the range 9.6-11.6 ppb.

A significant amount of benzene monitoring using diffusion tubes has been carried out in the London area (Moorcroft 1994). Diffusion tube measurements are useful for area-wide surveys if sampling periods can be kept short enough and ambient concentrations are high enough. They can be problematic particularly with extended sampling periods because of the reversible uptake of benzene on the adsorption medium employed. Mean benzene concentrations of up to 37 ppb have been found at roadside sites in close proximity to the kerbside. Typical mean benzene concentrations at roadside sites within 20 metres of busy roads, appear to cover the range 3-14 ppb. Such levels are consistent with the mean benzene concentrations estimated for Cromwell Road, London.

Annual mean benzene concentrations decrease with distance away from busy roads and diffusion tube surveys (Moorcroft 1994) point to the influence of busy roads extending out to about 100 metres before levels become indistinguishable from the urban background. On this basis, it is likely that motor vehicle traffic produce elevated benzene levels over a wide area in most urban centres.

Benzene emissions are reported from industrial sources, in addition to motor vehicles, (UK PORG 1993) and so there are questions concerning their contribution to urban exposure levels. The availability of two years data from the continuous hydrocarbon monitoring site at Longlands College, Middlesbrough has presented the opportunity to examine benzene levels in an urban background location which is potentially influenced by localised, industrial emissions. The hourly data for benzene shows the clear influence of sporadic peaks of benzene superimposed upon a steady baseline in a manner not found at the other EUN monitoring sites. These peaks have been tentatively associated with industrial sources (Derwent et al 1994) and the baseline with motor vehicle traffic. Despite there being significant peak hourly mean benzene concentrations of up to 55 ppb, annual mean concentrations are barely different from those reported for other urban background sites, see Table 4. Motor vehicle benzene emissions still appear to make a dominant contribution to annual mean ground level benzene concentrations in urban areas with significant industrial benzene sources.

3.2.2 Setting Targets

In setting an air quality standard for benzene, the Expert Panel on Air Quality Standards (EPAQS 1993) accepted that benzene is a genotoxic carcinogen and that no absolutely safe level can be defined. EPAQS set an air quality standard (AQS) for benzene at 5 ppb running annual mean and recommended a target AQS of 1 ppb for achievement at some date in the future. This study represents one contribution to the debate about how that date can be predicted.

3.2.3 Current Exceedances of the EPAQS Benzene AQS

Annual mean benzene concentrations at urban locations within 20 metres of busy roads are likely to exceed the EPAQS benzene AQS. At sites adjacent to the most heavily-trafficked roads, mean benzene concentrations may be double the EPAQS benzene AQS and localised maximum concentrations nearly eight times the AQS. Despite the magnitude of these exceedances, it is difficult to assess the contribution that roadside and kerbside concentrations make to the benzene exposure levels of the general population.

Annual mean urban background benzene concentrations monitored at the EUN Phase 2 Hydrocarbons Network sites, see Table 4, are all below the EPAQS benzene AQS because they are well away from the immediate influence of motor traffic. The Exhibition Road, London site approached the AQS, with its annual weekday mean benzene concentration of 4.6 ppb. This suggests that there might be urban background locations, particularly in the London area, where the EPAQS benzene AQS is exceeded.

Urban background mean benzene concentrations for each 5km x 5km grid square across the UK have been estimated from the observed benzene to nitrogen dioxide concentrations and the 1991 nitrogen dioxide diffusion tube survey of six monthly mean nitrogen dioxide concentrations (Campbell et al 1992). A small number of about 13 5km x 5km grid squares concentrated in the London area are expected to have mean benzene concentrations which exceed the EPAQS benzene AQS.

3.2.4 Current Exceedances of the EPAQS Target Benzene AQS

Exceedances of the EPAQS target benzene AQS at 1 ppb annual mean will necessarily be much more widespread than the 5 ppb AQS. Almost all locations within a 100 metres of a busy road are likely to have mean benzene concentrations which approach or exceed the target AQS. The mean urban background benzene concentrations at all but two of the EUN Phase 2 Hydrocarbons monitoring sites, see Table 4, exceed the target AQS.

About 3886 out of the 11155 5km x 5km grid squares across the UK, exceed the EPAQS target benzene AQS using the above relationship between long term mean benzene and nitrogen dioxide concentrations. These exceedance squares are distributed throughout all the major urban areas of the UK. There appear to be exceedances estimated for Scotland in contradiction to Table 4, where urban background benzene levels in Edinburgh are reported as below the EPAQS target benzene AQS. There remains the possibility that there are urban background locations where the EPAQS target benzene AQS is exceeded which are not being picked up by the EUN Phase 2 network monitoring sites.

3.3 Impact of Present Policies on Benzene Air Quality

In setting the EPAQS benzene AQS and the target benzene AQS, EPAQS were well aware of the importance of motor vehicle traffic as an urban source of benzene. Recent legislation requiring the introduction of catalytic converters on new cars and a check on emissions as part of the annual MOT (Dunne and Greening 1993) is expected to decrease these urban benzene exposure levels quite dramatically over the next 10-15 years. Table 5 presents the UK national total benzene emissions from all sources taken from UK PORG (1993) and DOE (1993). Future benzene emissions have been estimated using the same methodology as that adopted for future NO_x emissions (Eggleston 1992), from a consideration of:

* the penetration of petrol-engined vehicles fitted with three-way catalysts, their benzene emissions and their deterioration with vehicle miles driven;
* the impact of small canisters on evaporative benzene emissions;
* projections of vehicle mileage and ownership in the future;
* the impact of UK legislation and pending EC Directives on stationary hydrocarbon sources.

Table 5 presents projections of future benzene emissions for the years 2000 and 2010. On the basis of these projections, total benzene emissions are expected to decline by about 65% by the year 2010. Motor vehicle traffic emissions are expected to decline by 71% by the year 2010.

Assuming that these percentage reductions in benzene emissions are achieved evenly across the entire UK, then it is likely that by the year 2000 there will be no more exceedances of the EPAQS benzene AQS in urban background locations and in most roadside locations next to heavily-trafficked roads. There will still, however, be some roadside environments which, because of their close proximity to the most heavily-trafficked roads, will continue to exceed the EPAQS benzene AQS for the foreseeable future.

The impact of the projected decrease in benzene emissions from motor vehicle traffic by the year 2000, will be to reduce substantially the urban background concentrations of benzene. It is estimated that the number of 5km x 5km grid squares in which the EPAQS target benzene AQS is likely to be exceeded in the year 2000 will have been reduced from 3886 to 1368 out of 11155. This dramatic reduction in the area exceeding the target AQS is expected to have resulted from the reductions in benzene concentrations in suburban locations where the target AQS is currently exceeded by only a small margin. Reductions in urban background benzene concentrations are unlikely to be large enough to bring benzene concentrations below the target AQS in the majority of urban population centres.

On present expectations, benzene emissions from road traffic are anticipated to decrease further between the years 2000 and 2010. The number of 5km x 5km grid squares in which the EPAQS target benzene AQS is likely to be exceeded in the year 2010 should have been reduced from 3886 to 191 out of 11155. The number of exceedance squares should be reduced dramatically and areas of exceedance should have been eliminated in Scotland, Wales and Northern Ireland. However, most of the large population centres will still have areas in which it is expected that the EPAQS target benzene AQS is exceeded.

3.4 Additional Policy Options for Benzene

To achieve the EPAQS benzene target AQS at all urban background locations throughout the United Kingdom, a reduction in mean benzene concentrations and hence emissions of the order 82% on 1990 values is likely to be required. UK benzene emissions will therefore need to come down to below 7750 tonnes/yr, see Table 5. Emission projections, assuming the strict implementation of vehicle exhaust catalyst and evaporative emission control technologies, together with some action on stationary benzene sources (DOE 1993), indicate that benzene emissions are likely to be significantly higher, at about 15000 tonnes/yr in the year 2010.

The main benzene emission source categories anticipated in the year 2010 appear from Table 5 to be:

* petrol exhausts, due mainly to deterioration in the performance of catalysts with vehicle age;
* petrol refining and distribution, due mainly to the vehicle losses not controlled by small canisters and uncontrolled emissions from petrol station forecourts without vapour recovery systems.

Additional policy measures will therefore be required in addition to those already incorporated into the benzene emission projections if the EPAQS target benzene AQS is to met in urban background locations throughout the UK. Some of these additional measures could include:

* reductions in the sulphur content of petrol to halt the progressive deterioration in three way catalyst performance with vehicle mileage and age;
* implementation of strict Stage I and II emission controls, with large canisters on cars;
* reductions in both the aromatic and benzene content of petrol to minimise the impact of the imperfect control performance of catalyst and evaporative emission controls;
* stricter emission limits for oil refineries.

3.5 Conclusions on Benzene

The impact of present policies on the exceedances of the EPAQS AQS for benzene at various sites and locations is illustrated in Figure 2. At the most polluted locations, immediately adjacent to the most heavily-trafficked roads, both the EPAQS benzene and target benzene AQS will continue to be exceeded into the foreseeable future, at present traffic levels.

At urban roadside locations, within 20 metres of roads, exceedances of the EPAQS benzene AQS should have ceased by the year 2010, exceedances of the target AQS will continue into the foreseeable future, at present traffic levels.

At urban background locations, current exceedances of the EPAQS benzene AQS are unlikely to be widespread and are probably limited to within the London area. These exceedances should have ceased by the year 2000. Exceedances of the EPAQS target benzene AQS are currently widespread throughout all UK population centres. The area in which the target AQS is exceeded, should fall from 34% to 12% of the UK surface area by the year 2000. This area will still include the majority of the country's urban population. By the year 2010, this area will have decreased to 2% of the surface area of the UK. Exceedances in Scotland, Wales and Northern Ireland will have been eliminated. Areas still in exceedance will include the central areas of many of the major towns of England.

The complete elimination of exceedances of the EPAQS target benzene AQS at all urban background locations in England will require a 82% reduction in benzene emissions relative to their 1990 base. This is somewhat beyond current policies and implies some further policy development for future motor vehicle emissions and fuels.

Benzene concentrations in the suburban areas surrounding the major urban centres are expected to exceed the EPAQS target benzene AQS, currently. These exceedances are likely to have been eliminated completely by the year 2010.

4 IMPROVING CARBON MONOXIDE AIR QUALITY IN THE UNITED KINGDOM

4.1 Introduction to Carbon Monoxide

Carbon monoxide is widely distributed throughout the troposphere with concentrations that rise from about 50-60 ppb at the surface in the southern hemisphere (IPCC 1990) to about 100-200 ppb in the northern hemisphere (Derwent, Simmonds and Collins 1994). Mean concentrations at Mace Head, Ireland in surface air off the Atlantic Ocean were 128 +- 4 ppb over a three year period from 1990-1992. Carbon monoxide concentrations are typically an order of magnitude higher in urban and industrial centres where motor vehicle exhaust emissions are the largest source. Carbon monoxide, when inhaled, interferes with the vital function of oxygen transport throughout the human body. Sources, effects and concentrations of carbon monoxide in the UK are reviewed comprehensively elsewhere (Duggan, Hamilton and Revitt 1993).

4.2 Carbon Monoxide Air Quality: The Current Situation

4.2.1 Current Air Quality

The available carbon monoxide monitoring data for 1992 are summarised in Table 6, based on Bower et al (1994). Generally speaking, maximum 8-hour mean carbon monoxide concentrations at the urban sites established by Warren Spring Laboratory were in the range 5.7-12.5 ppm, consistently higher than the range of 2.7-6.0 ppm exhibited by the EUN Phase 1 sites. This is presumably due to the different siting criteria used in the two networks, resulting in EUN sites exhibiting a reduced exposure to the direct influence of local vehicle sources. In typical winters such as 1992, maximum 8-hour mean carbon monoxide concentrations in urban sites lie in the range 3.7-10.8 ppm, (that is excluding the 12.5 ppm monitored in Manchester).

The winter pollution episodes in December 1991 brought unprecedented carbon monoxide concentrations to the urban areas of south east England, in particular. Table 6 summarises the 1991 carbon monoxide monitoring in urban locations based on Broughton et al (1993). During severe pollution episodes, accumulation across an urban area begins to dominate over local influences and then any one kerbside site may not monitor the highest concentrations in a particular urban area. During the December 1991 episode in London, the Cromwell Road site reported a maximum 1-hour mean concentration of 16.7 ppm, whilst the West London site, 18.0 ppm. The corresponding maximum 8-hour mean concentrations on non-overlapping time periods also peaked at the West London site, 15.8 ppm, compared with Cromwell Road, 13.9 ppm.

Ambient carbon monoxide concentrations are highest in tunnels and in underground car parks. The highest carbon monoxide reported for the UK is 525 ppm in the Blackwall Tunnel (Duggan, Hamilton and Revitt 1993). It is difficult to identify the wider implications of the exposure of members of the general public to elevated carbon monoxide concentrations over 8-hour periods in these undoubtedly highly polluted environments.

4.2.2 Setting Targets

In setting the air quality standard for carbon monoxide, the Expert Panel on Air Quality Standards took careful account of the reversible nature of the human uptake of carbon monoxide (EPAQS 1994). They selected an 8-hour averaging period and considered that air quality data should be reported on a rolling mean basis. They chose a 10 ppm maximum 8-hour rolling mean carbon monoxide concentration for the Air Quality Standard (EPAQS 1994).

4.2.3 Current Exceedances of the EPAQS Carbon Monoxide AQS

The air quality data presented above in Tables 6 and 7, point to there having been exceedances of the EPAQS carbon monoxide AQS reported during 1991 in London and Glasgow and during 1992 in Manchester, Belfast and Birmingham. Additional exceedances have been reported in 1989 at the central London, Cromwell Road and Glasgow sites. From a consideration of the severe pollution episodes during which these exceedances of the EPAQS carbon monoxide AQS had occurred, it is likely that these exceedances were widespread throughout their respective urban areas. Proximity to particularly heavily-trafficked roads does not seem to have been an important issue here. Rather, it appears to be the overall level of motor vehicle emissions on days with poor atmospheric dispersion conditions which is the more important.

It is therefore concluded that, given the poor dispersion conditions associated with severe pollution episodes, urban background carbon monoxide concentrations could approach and exceed the EPAQS carbon monoxide AQS in many of the large urban centres of the United Kingdom with current levels of carbon monoxide emissions.

4.3 Impact of Present Policies on Carbon Monoxide Air Quality

In setting the EPAQS carbon monoxide AQS, EPAQS were well aware of the importance of motor vehicle traffic as an urban source of carbon monoxide. Recent legislation requiring the introduction of catalytic converters on new cars and a check on emissions as part of the annual MOT (Dunne and Greening 1993) is expected to decrease dramatically urban carbon monoxide exposure levels over the next 10-15 years.

Table 8 presents the UK national carbon monoxide emissions from all sources taken from HMSO (1994) and presents the projections for the years 2000 and 2010 from Eggleston (1992). The impact of the projected decrease in carbon monoxide emissions from motor vehicle traffic by the year 2000, will be to reduce substantially urban background concentrations of carbon monoxide. On present expectations, carbon monoxide emissions should decrease by 36-42% to the year 2000 and by 56-63% to the year 2010.

On the basis of the air quality data presented above, maximum 8-hour mean carbon monoxide concentrations need to decrease by about 35% to meet the EPAQS carbon monoxide AQS even during the conditions of severe pollution episodes. Such a level of emissions reductions on the road transport sector is anticipated by the year 1998-2000 and for all carbon monoxide sources with about 1-2 years delay.

The questions then remain about the assumed relationship between carbon monoxide emissions and urban background carbon monoxide concentrations. Derwent et al (1995)

have carefully compared the weekday measurements of carbon monoxide made at Exhibition Road, London with the results of simple air pollution models based on current emissions inventory estimates. The required motor traffic emission factor of 23-30 g/km compares well with that assumed in the NAEI (Eggleston 1992) and that measured on-board in motor vehicles undergoing urban driving (Bailey, Schmidl and Williams 1990).

Current best estimates of the trends in mean urban carbon monoxide concentrations are difficult to ascertain because of the adequacy of previous monitoring techniques and the shortage of sites with adequate long term monitoring records. Annual mean and 98-percentile hourly mean carbon monoxide concentrations have probably increased at Stevenage and central London but probably decreased at Cromwell Road, London over the last decade. The overall increase at the central London site amounts to 0.04 +- 0.03 ppm/yr or 3 +- 2 %/yr. This is reported by QUARG (1993) to be consistent with the UK-wide 32% increase in carbon monoxide emissions from 1980 to 1990 (Eggleston 1992) which compounds together estimates of changes in vehicle emission factors with motor vehicle usage. This same emissions methodology points to a turn-over in emissions in 1991 and emissions declining hereafter. This turnover in urban carbon monoxide concentrations has yet to be observed.

Rural background mean carbon monoxide concentrations are, in contrast, already falling quickly. Carbon monoxide concentrations at Mace Head, Ireland have been falling by about 28 ppb/yr or 13%/yr in polluted air masses arriving from the European continent (Derwent, Simmonds and Collins 1994). This has been attributed to the increasing use of motor vehicle emission control technologies elsewhere in Europe which have been implemented significantly in advance of the UK.

4.4 Conclusions on Carbon Monoxide

The impact of present policies on the exceedance of the EPAQS AQS for carbon monoxide at various sites and locations is illustrated in Figure 3. On this basis, carbon monoxide concentrations are set to fall significantly across the UK and this fall should be detectable by the EUN monitoring network. Exceedances of the EPAQS carbon monoxide AQS should become a matter of historical record throughout the UK rather than an unwelcomed feature of future urban air quality.

5 IMPROVING 1,3-BUTADIENE AIR QUALITY IN THE UNITED KINGDOM

5.1 Introduction

1,3-butadiene is an organic compound that is widely distributed in the ambient atmosphere. Almost all of the 1,3-butadiene found at ground level in the northern hemisphere is likely to have originated from human activities, in particular, the combustion of petroleum products by motor vehicle engines. 1,3-butadiene is classed as a human genotoxic carcinogen and workers exposed to high concentrations have run the small but definite risk of developing certain types of leukaemia. Sources, effects and concentrations of 1,3-butadiene in the UK are reviewed comprehensively elsewhere (Duggan, Hamilton and Revitt 1993).

5.2 1,3-Butadiene Air Quality: The Current Situation

5.2.1 Current Air Quality

Until recently there were hardly any measurements of 1,3-butadiene at all for the UK. The first reported long term UK benzene measurements were for rural locations:

* Great Dun Fell, Cumbria, 1989-1991, 0.01 ppbp;

* West Beckham, Norfolk, 1989-1991, 0.04 ppb.

These early measurements used sporadic bottle samples, followed by gas chromatographic analysis.

Continuous hourly urban measurements using cryotrapping sampling with gas chromatographic detection began in July 1991 and continued for one year at a roadside site in Exhibition Road, London (Field et al 1994). The long term annual mean 1,3-butadiene concentration reported during 1991-92 was 0.86 ppb. These measurements, which are described in detail elsewhere (Derwent et al 1994), confirmed that motor vehicle traffic movements in Exhibition Road and in the wider area of central London, accounted for the greater part of the 1,3-butadiene concentrations found at that roadside location. The 1,3-butadiene emissions from motor traffic required to explain the observed 1,3-butadiene concentrations amounted to about 16-25 mg/km travelled, in reasonable agreement with the on-board vehicle measurements of 34 mg/km travelled (Bailey et al 1990).

Table 9 presents the available 1,3-butadiene measurements for urban background sites from the network of continuous, automatic cryotrapping gas chromatographs fitted with telemetric data collection and analysis (Dollard et al 1994b). Generally speaking, the urban background 1,3-butadiene concentrations reported in Table 9 are considered typical of the urban exposure levels of a large section of the general population. Monthly mean 1,3-butadiene concentrations cover the wide range of 0.1-4.9 ppb and annual mean concentrations, where sites have been running long enough, 0.2-0.6 ppb.

Continuous hourly 1,3-butadiene concentration measurements have yet to be made in the UK at the kerbside of the most heavily-trafficked roads. Although the Exhibition Road, London measurements of Derwent et al (1995) do not come into this category, they can be used to estimate such concentrations in conjunction with the Cromwell Road, London kerbside NO_x and carbon monoxide concentrations. On this basis, it is estimated that mean 1,3-butadiene concentrations at the kerbside adjacent to heavily trafficked roads may lie in the range 1.7-2.7 ppb.

Because of its much lower boiling point compared with benzene, it has not yet been possible to monitor 1,3-butadiene concentrations with diffusion tubes. However, all available evidence points to benzene and 1,3-butadiene having closely analogous sources in the urban environment. It is therefore reasonable to suppose that their concentration distributions share similar features, particularly close into sources.

1,3-butadiene emissions are reported from industrial sources, in addition to motor vehicles and so there are questions concerning their contribution to urban exposure levels. The availability of two years data from the continuous hydrocarbon monitoring site at

Longlands College, Middlesbrough presents an opportunity to examine 1,3-butadiene levels in an urban background location which is potentially influenced by localised, industrial emissions. The hourly data for 1,3-butadiene shows the clear influence of sporadic peaks superimposed upon a steady baseline in a manner not found at the other EUN monitoring sites. These peaks have been tentatively associated with industrial sources (Derwent et al 1994) and the baseline with motor vehicle traffic. Despite there being significant peak hourly mean 1,3-butadiene concentrations, the annual mean concentrations for 1992 and 1993 of 0.35 and 0.45 ppb, respectively, are not noticeably different from those reported for other urban background sites, see Table 12. Motor vehicle 1,3-butadiene emissions still appear to make a dominant contribution to annual mean ground level concentrations in urban areas with significant industrial sources.

5.2.2 Setting Targets

In setting an air quality standard for 1,3-butadiene, the Expert Panel on Air Quality Standards (EPAQS 1994) accepted that 1,3-butadiene is a genotoxic carcinogen and that no absolutely safe level can be defined. EPAQS set an air quality standard (AQS) for 1,3-butadiene at 1 ppb running annual mean.

5.2.3 Current Exceedances of the EPAQS 1,3-butadiene AQS

Annual mean 1,3-butadiene concentrations at urban locations within 20 metres of busy roads are likely to exceed the EPAQS 1,3-butadiene AQS. At sites adjacent to the most heavily-trafficked roads, mean 1,3-butadiene concentrations may be double or treble the EPAQS 1,3-butadiene AQS based on extrapolated concentrations for kerbside sites such as Cromwell Road, London. Despite the magnitude of these exceedances, it is difficult to assess the contribution that roadside and kerbside concentrations make to the 1,3-butadiene exposure levels of the general population.

Annual mean urban background 1,3-butadiene concentrations monitored at the EUN Phase 2 Hydrocarbons network sites, see Table 12, are all below the EPAQS 1,3-butadiene AQS because they are well away from the immediate influence of motor traffic. The concentrations measured at the Exhibition Road, London site approached the AQS, with its annual weekday mean 1,3-butadiene concentration of 0.8 ppb (Derwent et al 1995). This suggests that there might be urban locations, particularly in the London area, where the EPAQS 1,3-butadiene AQS is exceeded.

Urban background mean 1,3-butadiene concentrations for each 5km x 5km grid square across the UK have been estimated from the observed 1,3-butadiene and nitrogen dioxide concentrations and the 1991 nitrogen dioxide diffusion tube survey of six monthly mean nitrogen dioxide concentrations (Campbell et al 1992). A small number of 5km x 5km grid squares concentrated in the London area are expected to have mean 1,3-butadiene concentrations which exceed the EPAQS 1,3-butadiene AQS.

5.3 Impact of Present Policies on 1,3-Butadiene Air Quality

In setting the EPAQS 1,3-butadiene AQS, EPAQS were well aware of the importance of motor vehicle traffic as an urban source of 1,3-butadiene. Recent legislation requiring the introduction of catalytic converters on new cars and a check on emissions as part of the

annual MOT (Dunne and Greening 1993) is expected to decrease these urban 1,3-butadiene exposure levels quite dramatically over the next 10-15 years.

No estimates are available for the UK of 1,3-butadiene emissions from sources other than the exhaust emissions of motor vehicles. Future 1,3-butadiene emissions can be estimated using the same methodology as that adopted for future NO_x emissions (Eggleston 1992), from a consideration of:

* the penetration of petrol-engined vehicles fitted with three-way catalysts, their 1,3-butadiene emissions and their deterioration with vehicle miles driven;
* projections of vehicle mileage and ownership in the future.

Current UK 1,3-butadiene emissions from petrol cars are estimated to be about 5500 tonnes/yr in 1992 on the basis of the emissions in central London required to account for the observed concentrations (Derwent et al 1994). The above projections lead to future 1,3-butadiene emissions for the years 2000 and 2010 of 2500 and 1500 tonnes/yr, respectively. On this basis, petrol-engined motor vehicle 1,3-butadiene emissions are expected to decline by about 55% by the year 2000 on their 1992 values and by 73% by the year 2010.

Assuming that these percentage reductions in 1,3-butadiene emissions are achieved evenly across the entire UK, then it is likely that by the year 2000 there will be no more exceedances of the EPAQS 1,3-butadiene AQS in urban background locations and in most roadside locations next to heavily-trafficked roads. There may well, however, be some roadside environments which, because of their close proximity to the most heavily-trafficked roads, will continue to exceed the EPAQS 1,3-butadiene AQS for the foreseeable future.

5.4 Conclusions on 1,3-Butadiene

The impact of present policies on the exceedance of the EPAQS AQS for 1,3-butadiene at various sites and locations is illustrated in Figure 4. At the most polluted locations, immediately adjacent to the most heavily-trafficked roads, the EPAQS 1,3-butadiene AQS may well still continue to be exceeded into the foreseeable future, at present traffic levels.

At urban roadside locations, within 20 metres of roads, exceedances of the EPAQS 1,3-butadiene AQS should have ceased by the year 2010. At urban background locations, current exceedances of the EPAQS 1,3-butadiene AQS are unlikely to be widespread and are probably limited to within the London area. Such exceedances should have ceased by the year 2000.

6 ACKNOWLEDGMENTS

The help of Geoff Dollard and Jon Bower at NETCEN in compiling the air quality data for benzene, 1,3-butadiene and carbon monoxide, and of Simon Eggleston at NETCEN with the emission inventories and projections is gratefully acknowledged. The support and encouragement of the Department of the Environment through the Air Quality Research programme and contract EPG 1/3/16 is deeply appreciated.

7 BIBLIOGRAPHY

Bailey JC, Schmidl B and Williams ML (1990). Speciated hydrocarbon emissions from vehicles operated over the normal speed range on the roads. *Atmospheric Environment*, 24A, 43-52.

Bower JS et al (1994). Air pollution in the UK: 1992/93. Warren Spring Laboratory report LR1000(AP). WSL, Stevenage, Herts.

Broughton GFJ et al (1993). Air quality in the UK: A summary of results from instrumented air monitoring networks in 1991/92. Warren Spring Laboratory Report LR941(AP). WSL, Stevenage, Herts.

Builtjes PJH (1987). Photochemical oxidant and acid deposition model (PHOXA). Calculation and evaluation of the photochemical episode of 22-26 July. TNO Report 87-278, Apeldoorn, The Netherlands.

Builtjes PJH (1992). The LOTOS - long term ozone simulation project: Summary report. TNO Report IMW R92/240. TNO Institute of Environmental Sciences, Delft, The Netherlands.

Campbell GW, Cox J, Downing CEH, Stedman JR and Stevenson KJ (1992). A survey of nitrogen dioxide concentrations in the United Kingdom using diffusion tubes: July to December 1991. Warren Spring Laboratory Report LR 893(AP), Stevenage, Herts.

CEC (1991). CORINAIR NOx emissions for 1985. Commission of the European Communities DG XI/TF EEA-Corine, report 09/91. Brussels, Belgium.

Clark AI, McIntyre LE, Perry R and Lester JN (1984). Monitoring and assessment of ambient atmospheric concentrations of aromatic and halogenated hydrocarbons at urban, rural and motorway locations. Environmental Pollution Series B, 7, 141-148.

Derwent RG (1989). A comparison of model photochemical ozone formation potential with regional scale ozone formation during a photochemical episode over the United Kingdom. *Atmospheric Environment*, 23, 1361-1371.

Derwent RG (1990). Evaluation of a number of chemical mechanisms for their application in models describing the formation of photochemical ozone in Europe. *Atmospheric Environment*, 24A, 2615-2624.

Derwent RG and Davies TJ (1994). Modelling the impact of NOx or hydrocarbon control on photochemical ozone in Europe. *Atmospheric Environment*, 28, 2039-2052.

Derwent RG and Jenkin ME (1991). Hydrocarbons and the long range transport of ozone and PAN across Europe. *Atmospheric Environment*, 25A, 1661-1678.

Derwent RG, Middleton DR, Field RA, Goldstone ME, Lester JN and Perry R (1995). Analysis and interpretation of air quality data from an urban roadside location in Central London over the period from July 1991 to July 1992. *Atmospheric Environment*, 29, 923-946.

Derwent RG, Simmonds PG and Collins WJ (1994). Ozone and carbon monoxide measurements at a remote maritime location, Mace Head, Ireland, from 1990 to 1992. *Atmospheric Environment*, 28, 2623-2637.

Derwent J et al (1994). A preliminary analysis of hydrocarbon monitoring data from an urban site. AEA Technology Report 18358030/05. NETC, Culham Laboratory, Oxfordshire.

DOE (1993). Reducing emissions of volatile organic compounds (VOCs) and levels of ground level ozone: a UK strategy. Air Quality Division, Department of the Environment, London.

DOE (1994). Improving air quality. A discussion paper on air quality standards and managment. Air Quality Division, Department of the Environment, London.

DOE (1995). Air quality: meeting the challenge. Department of the Environment, London.

Dollard GJ, Jones BMR, Nason P, Chandler J, Davies T, Dumitrean P and Delaney M (1994a). The UK hydrocarbon monitoring network. Report AEA-CS-18358030-01. NETC, Culham Laboratory, Oxfordshire.

Dollard GJ et al (1994b). Data summary from the hydrocarbons monitoring network.

Duggan M, Hamilton R and Revitt M (1993). Air quality fact sheets: benzene. Urban Pollution Research Centre, Middlesex University Services Ltd, Middlesex University, London.

Dunne JM and Greening PJ (1993). European emission standards to the year 2000. Paper presented to the Institution of Mechanical Engineers Seminar "Worldwide emission standards and how to meet them", I. Mech. E., London.

Eggleston HS (1992). Pollution in the atmosphere: Future emissions from the United Kingdom. Warren Spring Laboratory Report LR (888)AP. WSL, Stevenage, Herts.

EPAQS (1993). Expert Panel on Air Quality Standards. Benzene. HM Stationery Office, London.

EPAQS (1994). Expert Panel on Air Quality Standards. Carbon monoxide. HM Stationery Office, London.

EPAQS (1994). Expert Panel on Air Quality Standards. Ozone. HM Stationery Office, London.

EPAQS (1994). Expert Panel on Air Quality Standards. 1,3-butadiene. HM Stationery Office, London.

Field RA, Goldstone ME, Lester JN and Perry R (1994). The variation in volatile hydrocarbon concentrations in Central London between 1986 and 1992. *Environmental Technology Letters*, to be published.

Fuhrer J and Achermann B (1994). Critical levels for ozone: a UN ECE workshop report. Schriftenreihe der les cahiers de la FAC Liebefeld nummer 16, Federal Research Station for Agricultural Chemistry and Environmental Hygiene, Liebefeld-Bern, Switzerland.

Hass H (1991). Description of the EURAD chemistry-transport-model version 2 (CTM-2). Mitteilungen aus dem Institut fur Geophysik und Meteorolgie der Universität zu Köln, Germany.

Heymann M, Trukenmuller A. and Friedrich R. (1993). Development prospects for emission inventories and atmospheric transport and chemistry models. IER, Stuttgart University, Germany.

HMSO (1990). This common inheritance. Britain's environmental strategy. Cm 1200. HM Stationery Office, London.

HMSO (1994). Digest of Environmental Protection Statistics 1993. HM Stationery Office, London.

Iversen T (1991). Comparison of three models for long term photochemical oxidants in Europe. EMEP/MSC-W Report, 3/91. The Norwegian Meteorological Institute, Oslo, Norway.

Moorcroft S (1994). London wide environmental programme: benzene survey. TBV Science, Croydon.

Murlis J and Derwent RG (1993). Development of an effects-based policy for the control of photochemical pollution. Proceedings of the EMEP Workshop on the control of photochemical oxidants in Europe. pp155-170. Finnish Meteorological Institute, Helsinki, Finland.

Nordic Council of Ministers (1991). Photochemical oxidants in the atmosphere. Nord 1991:7. Nordic Council of Ministers, Copenhagen.

Passant NR (1993). Emissions of volatile organic compounds from stationary sources in the United Kingdom: A review of emission factors by species and process (September 1993 update). Warren Spring Laboratory Report LR990. WSL, Stevenage, Herts.

Simpson D and Hov O (1990). Long period modelling of photochemical oxidants in Europe. Calculations for July 1985. EMEP/MSC-W Note 2/90. The Norwegian Meteorological Institute, Oslo, Norway.

UK PORG (1993). Ozone in the United Kingdom 1993. Photochemical Oxidants Review Group, Department of the Environment, London.

WHO (1987). Air quality guidelines for Europe. World Health Organisation Regional Publications, European Series No. 23, WHO, Copenhagen, Denmark.

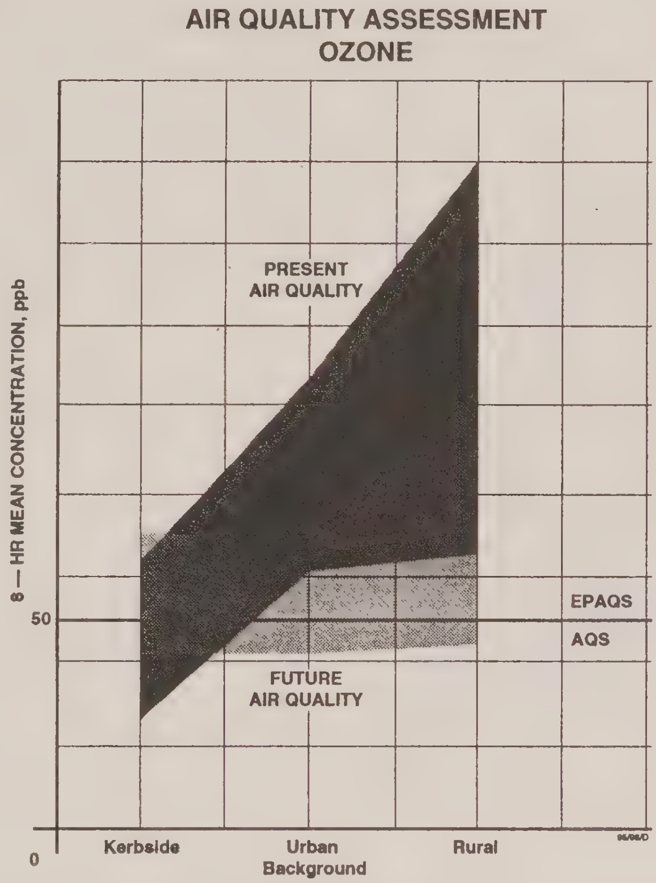


Figure 1: Air Quality Assessment for the Present Day and for the Year 2010 for Ozone

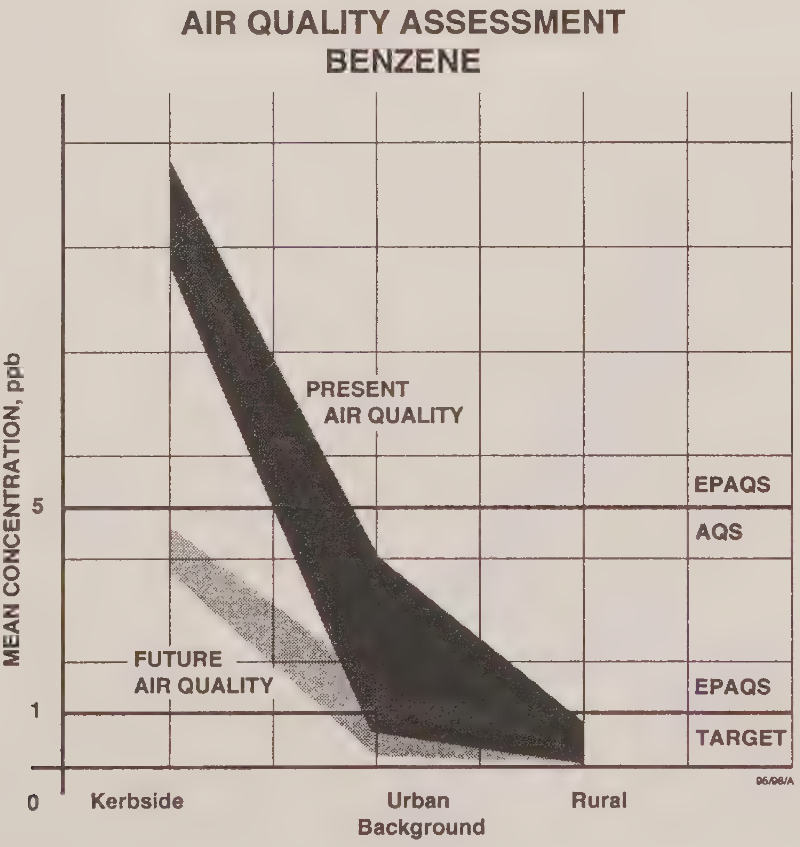


Figure 2: Air Quality Assessment for the Present Day and for the Year 2010 for Benzene

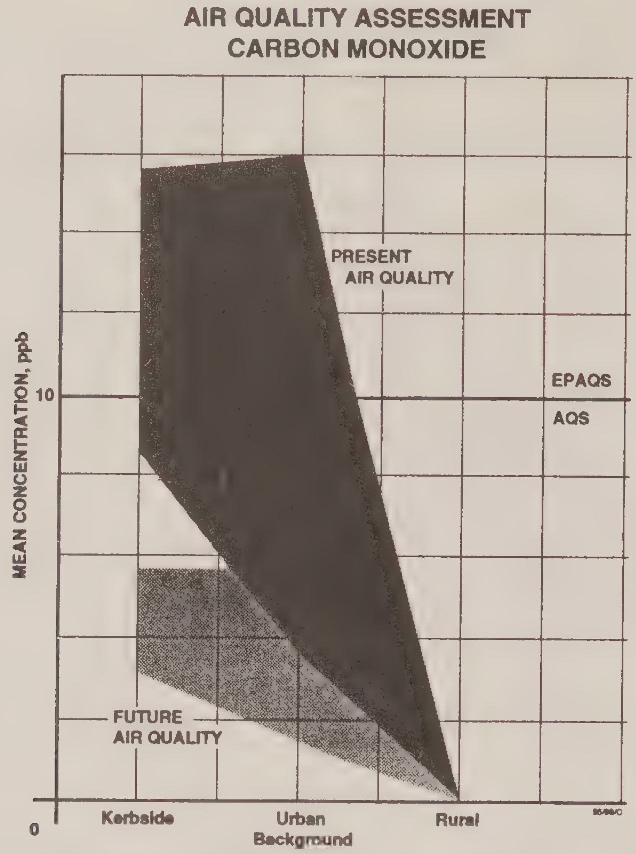


Figure 3: Air Quality Assessment for the Present Day and for the year 2010 for Carbon Monoxide

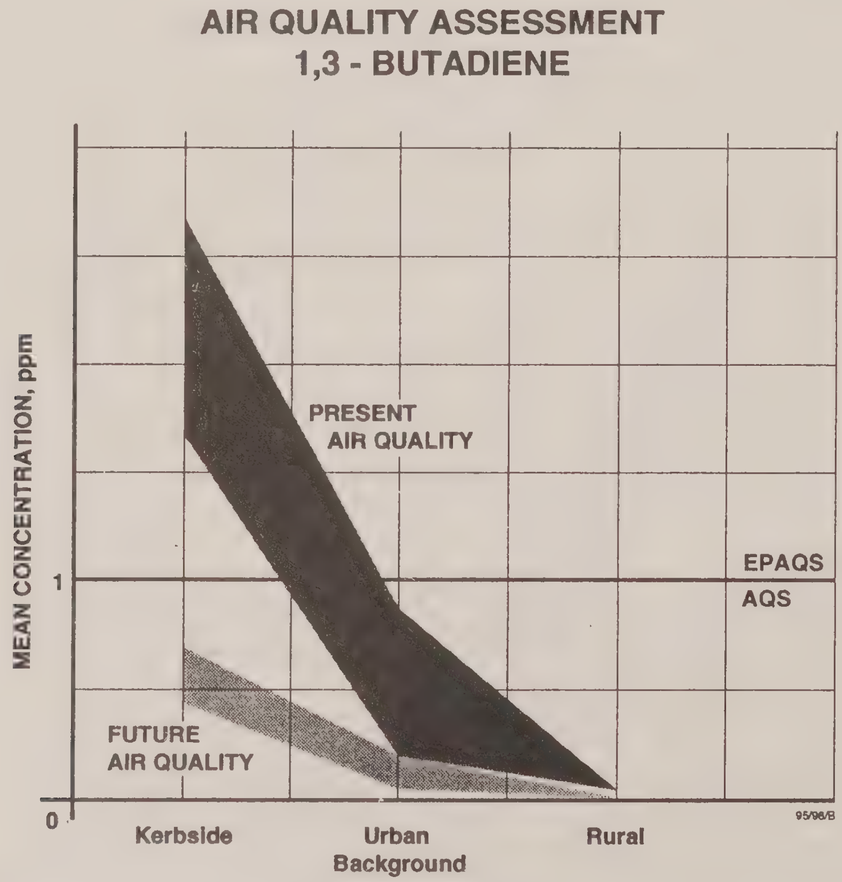


Figure 4: Air Quality Assessment for the Present Day and for the Year 2010 for 1,3-Butadiene

Table 1: The Frequency of Exceedance of the EPAQS Ozone AQS During 1990, a Summer with a High Prevalence of Photochemical Pollution Episodes

Site	Number of days in which AQS was exceeded	Site	Number of days in which AQS exceeeded
Aston Hill	44	Ladybower Res	22
Bottesford	10	Lough Navar	15
Bush	14	Lullington Heath	56
Central London	5	Mace Head	25
Dursley	26	Sibton	26
Eskdalemuir	18	Stevenage	14
Fawley	11	Strath Vaich	19
Glazebury	10	Teddington	20
Great Dun Fell	25	Wharleycroft	18
Harwell	31	Yarner Wood	40
High Muffles	23	York	0

Source: UK PORG (1993).

Table 2: Maximum Hourly Mean Ozone Concentrations Reported for 1990-1992 in ppb and the Base Case Results from the UK Photochemical Trajectory Model

Site	1990	1991	1992
Stevenage	136	84	89
Sibton	145	86	116
Central London	108	63	76
Aston Hill	124	68	95
Lullington Heath	161	118	98
Strath Vaich	80	71	74
High Muffles	111	86	94
Lough Navar	94	90	81
Yarner Wood	147	120	108
Ladybower Res	120	82	107
Harwell	132	91	116
Bottesford	138		95
Bush	100	77	80
Eskdalemuir	106	78	75
Great Dun Fell	114	95	132
Wharley Croft	102	90	100
Glazebury	96	77	106

Photochemical model results in ppb.

UK Photochemical Trajectory model	3rd Day	4th Day	5th Day
location	Kent/Sussex	Central England	Ireland
peak ozone concentration, ppb	83	126	138

Sources: Broughton et al (1993); Bower et al (1994); UK PORG (1993); Derwent and Jenkin (1991).

Table 3: Assessment of the Impact of Current Policies on the Model Calculated Peak Ozone Concentrations in the Year 2000 Across the Southern British Isles

UK Photochemical Trajectory model	3rd Day	4th Day	5th Day

Base Case

location	Kent/Sussex	Central England	Ireland
peak ozone concentration, ppb	83.0	126.3	137.9

Current policies by the year 2000, low scenario, changes relative to base case in ppb.

15% NO_x control	+3.9	+1.7	-3.5
40% HC control	-16.4	-32.8	-16.4
35% CO control	-4.0	-8.7	-8.5
32% SO_2 control	+0.3	-0.2	-0.8
Overall change	-16.2	-40.0	-29.2
% reduction in O_3	19.5%	31.7%	21.2%

Current policies by the year 2000, high scenario, changes relative to base case in ppb.

30% NO_x control	+4.0	-1.1	-9.2
40% HC control	-16.4	-32.8	-16.4
35% CO control	-4.0	-8.7	-8.5
46% SO_2 control	+0.4	-0.4	-0.9
Overall change	-16.0	-43.0	-35.0
% reduction in O_3	19.3%	34.0%	25.4%

Table 4: Monthly mean benzene concentration in ppb monitored at urban background locations within the DoE EUN Phase 2 Hydrocarbons Network.

	Belfast	Bristol	B'ham	Cardiff	E'burgh	Ldn	Leeds	M'borough	Ldn
Jan-94	1.25		1.04	1.95	0.66	0.95		1.06	1.66
Feb-94	1.68		1.53	2.23	0.92	1.44		1.36	2.80
Mar-94	0.72		0.67	0.93	0.40	0.75		0.88	1.16
Apr-94	0.77		0.63	0.85	0.56	0.53		2.15	1.26
May-94	0.91	1.10	0.65	1.08	0.52	0.81		1.14	2.17
Jun-94	0.62	0.62	0.51	0.75	0.38	0.86		0.46	1.31
Jul-94	0.66	0.76	0.77	0.95	0.56	0.91		1.71	1.54
Aug-94	0.72	0.91	0.74	0.97	0.55	0.83		1.02	1.31
Sep-94	1.15	1.15	0.82	1.10	0.60	0.98		2.38	1.57
Oct-94	1.64	1.81	1.53	2.32	0.84	1.39		1.54	2.32
Nov-94	1.50	1.31	1.68	2.30	0.79	1.71		1.55	2.08
Dec-94	1.58	1.34	1.78	1.99	0.76	1.92		0.74	2.17
Jan-95	1.09	1.02	0.86	1.37	0.72	1.19	1.08	0.85	1.23
Feb-94	0.86	1.09	0.66	1.16	0.60	0.96	0.78	0.71	1.11

Source: Dollard et al. (1994b).

Table 5: Total Emissions of Benzene for the UK for 1990 and 2010

Source Category	1990	2010
Benzene emissions in tonnes/year		
petrol exhaust	33 000	9 000
diesel exhaust	1 000	1 000
petrol evaporation	3 346	837
stationary combustion	943	943
petrol refining and distribution	4 410	2 790
natural gas leakage	377	377
iron and steel manufacture	0	0
landfill	0	0
total	43 076	14 947

Notes:

a: UK PORG (1993); base year 1990. DoE (1993). Derwent et al. (1995).

b: Eggleston (1992).

Table 6: Air Quality Data for Carbon Monoxide for Urban Sites During 1992 Showing Maximum 8-hour Mean Concentrations for the Widest Range of Urban Centres in the UK.

Monitoring Site	Type of Site	Maximum 8-hour rolling mean carbon monoxide concentration, ppm
Stevenage, Herts	suburban	3.0
Cromwell Road, London	kerbside	8.7
West London	urban	6.3
Glasgow	urban	8.7
Manchester	urban	12.5
Sheffield	urban	7.4
Bridge Place, London	urban	6.6
London Bloomsbury	EUN	4.5
Edinburgh Centre	EUN	3.7
Cardiff Centre	EUN	4.9
Belfast Centre	EUN	10.3
Birmingham Centre	EUN	10.8
Newcastle Centre	EUN	4.0

Table 7: Air Quality Data for Carbon Monoxide for Urban Sites During 1991 Showing the Influence of the Severe Pollution Episodes During December 1991 at Some Sites

Monitoring Site	Type of Site	Maximum 8-hour rolling mean carbon monoxide concentration, ppm
Stevenage, Herts	suburban	4.9
Cromwell Road, London	kerbside	13.9
West London	urban	15.8
Glasgow	urban	12.5
Manchester	urban	5.7
Sheffield	urban	6.3
Bridge Place, London	urban	11.2

Table 8: UK Emissions of Carbon Monoxide for the Years 1992, 2000 and 2010 in Thousand Tonnes/yr.

Source	1992 (a)	1992 (b)	2000 (b)	2010 (b)
Domestic	277			
Commercial & Public Service	10			
Industry	86			
Agriculture	2			
Road Transport	6047	5956	3481	2221
			3826	2642
Other transport	50			
Misc	17			
Other emissions	220			

Notes:

(a) HMSO (1994).

(b) Eggleston (1992).

Table 9: Monthly mean 1, 3-butadiene concentrations in ppb monitored at urban background locations within the DoE EUN Phase 2 Hydrocarbons Network.

	Belfast	Bristol	B'ham	Cardiff	E'burgh	Ldn	Leeds	M'borough	Ldn
Jan-94	0.23		0.23	0.90		0.17		0.22	0.38
Feb-94	0.28		0.28	0.49	0.14	0.19		0.23	0.58
Mar-94	0.12		0.13	0.20	0.08	0.26		0.64	0.25
Apr-94	0.12		0.12	0.20	0.09	0.47			0.48
May-94	0.13	0.24	0.13	0.22	0.10	0.16		0.08	0.66
Jun-94	0.10	0.16	0.11	0.15	0.06	0.18		0.08	0.27
Jul-94	0.11	0.18	0.15	0.18	0.08	0.17		0.18	0.35
Aug-94	0.12	0.23	0.17	0.17	0.09	0.18		0.18	0.32
Sep-94	0.22	0.31	0.19	0.20	0.09	0.25		0.73	0.35
Oct-94	0.31	0.91	0.35	0.30	0.13	0.35		0.25	0.43
Nov-94	0.29	0.62	0.42	0.33	0.12	0.44		0.31	0.39
Dec-94	0.33	0.13	0.44	0.28	0.13	0.46		0.17	0.30
Jan-95	0.21		0.20	0.21	0.12	0.30	0.33	0.15	0.29
Feb-94	0.15	0.24	0.16	0.22	0.08	0.22	0.27	0.13	0.26

Source: Dollard et al. (1994b).

LOCAL AIR QUALITY MANAGEMENT IN THE UK SURVEY

Helen Crabbe and Derek M. Elsom
Air Quality Management Research Group
Oxford Brookes University

Introduction

In the year since the NSCA published the results of its 1993 national survey of local authority air pollution monitoring activities[1] there have been many further developments connected with developing local air quality management in the UK. To obtain an updated insight into progress towards local air quality management a questionnaire was sent to 88 environmental health departments, chosen by their local authority resident population being over 80,000. The results from 84 completed questionnaires are summarised here. The survey represents a snapshot survey of the state of local air quality management systems in October-November 1994 as well as revealing details of local authority plans for the future. The survey excluded local authorities in Greater London as these are the focus of a separate survey and their progress towards air quality management has been documented recently by the South East Institute of Public Health (SEIPH)[2,3].

Survey Results

1. Which air pollutants do you monitor regularly and with what equipment? [see Table at the end of this report]

The monitors were grouped by the type of pollutant being measured as well as according to whether the monitors were manual or real-time analysers. Responses also indicated whether the monitors were sited at roadside/kerbside, urban background, suburban or industrial locations (details available from the authors).

Although the government-funded Enhanced Urban Network (EUN) enables 12 local authorities (outside Greater London) to provide real-time continuous monitoring, 26 other local authorities have been able to find the resources to install and maintain real-time monitoring sites and several of the authorities with EUN stations have also introduced additional analysers and monitoring sites. Birmingham, Bristol, Cardiff, Leeds, Leicester and Sheffield have the most extensive monitoring capabilities (outside Greater London). Nevertheless, this table highlights that 46 out of the 84 (55%) major urban authorities do not have permanent real-time monitors and consequently are unable to assess adequately whether they experience serious air quality problems or not, especially in relation to say episodes of poor air quality. Seven authorities have the monitoring flexibility that is provided by mobile/transportable monitoring units and the existence of such equipment raises the possibility of neighbouring authorities agreeing to share monitoring capabilities. Six authorities use Opsis equipment which accounts for half of the authorities monitoring benzene and other VOCs using automatic analysers (note: the number of EUN Phase II stations monitoring VOCs has increased since the survey was conducted). Diffusion tubes are widely used by most local authorities with 77 out of 84 (92%) authorities measuring NO_2 and a few measuring benzene, VOCs, ozone, carbon monoxide and ammonia using this method.

2. Do you compile information on the sources and magnitude of local pollution emissions (i.e. a 1 x 1 km grid local emissions inventory)?

Yes – 11: *Bristol (initial survey partially complete); West Midlands Emission Inventory covering Birmingham, Coventry, Dudley, Sandwell (sponsored by the DoE as a follow-up to the Greater London inventory and being undertaken by the London Research Centre); Liverpool (linked into the Emergency Planning Unit and covering the Merseyside area); Middlesbrough (part of a PhD project into dispersion modelling); Sheffield (point, area and line emission sources have been compiled as inputs into the Indic Airviro computer modelling system); Tunbridge Wells (Kent-wide emission inventory being used as input into the Maidstone Initiative for Sustainable Transport, MIST, project); Belfast (smoke and sulphur dioxide emission inventory completed December 1992 by the Northern Ireland DoE); and Stockport (being undertaken currently).*

No – 73.

Although authorities have produced emission details for prescribed Part B processes, few have attempted the time-consuming task of compiling 1 x 1 km grid emission inventories which can be used as input into urban-wide air quality dispersion models (or even county-wide in the case of the Kent initiative). QUARG recommends that emission inventories should be prepared for all 22 urban areas with populations exceeding 200,000[4]. It is hoped that the West Midlands inventory will lead to a user-friendly software package which other local authorities can utilise.

3. When classifying the air quality in your area, do you use the DoE air quality bands or your own bandings?

46 authorities use DoE bandings; 8 use their own bandings (Birmingham, Bristol, Coventry, Middlesbrough and Plymouth use a numerical and descriptive variation on the DoE bandings whereas Bath, Doncaster and Rotherham use the DoE bandings but apply different descriptors); 3 use WHO guidelines as well as DoE bands (Leeds, Manchester, Wigan); 4 use EC directive guide and limit values (Bournemouth, Exeter, Swindon, Eastbourne - use NO2 EC Directive levels because they can be compared to diffusion tube analysis) and Glasgow uses DoE bands and on occasions uses it own 'norms' derived from the Glasgow Eastern Area Renewal (GEAR) survey.

15 undertake no classification and 11 authorities provided no response.

The variety of air quality bands employed by local authorities indicates there is a clear need for a revision of the DoE bands. National standards to classify and describe air quality levels which are acceptable to all authorities would be widely welcomed and would avoid confusion amongst the public.

4. Do you communicate air quality information to the public on a daily basis? If so, how is this done?

Yes – 19; No – 65 *(but 17 plan to do so).*

Current methods used: *<u>local press/radio/television</u> (information is telephoned or faxed, but it is not always used by the media, in Birmingham, Bristol, Cardiff, Huddersfield/Kirklees, Hull, Leicester, Maidstone, Middlesbrough, Oxford, Plymouth,*

Rotherham, Sheffield). Public information points (Cardiff, Doncaster, Maidstone, Newcastle, Plymouth, Southampton – a screen in the local environmental centre). Electronic screens (i.e. Electronic Information display Boards (EIBs) are used in public areas in Brighton, Leeds, Leicester, Rotherham, Bath – a screen display in a graphical form, updated hourly). Fax bulletins to clients (e.g. Middlesbrough send to leisure centres, libraries, retail outlets, schools/colleges as well as the local evening paper). Weekly summaries to local newspapers (Coventry, Huddersfield, Rotherham) and a monthly air quality bulletin newsletter (Leicester).

***Plans to do so:** electronic screens (Huddersfield, Hull, Liverpool, Plymouth, Stockport, Swansea); telephone link to local press/radio (Brighton); radio bulletins throughout the day (Rotherham) and Public information points (Stockton-on-Tees, Walsall, Manchester –as part of an Environmental Information Centre, air quality information would include VDU display, leaflets and contact officers for further information).*

Only 23% of local authorities disseminate air quality data to the public on a daily basis. Given the variety of dissemination methods used currently to inform the public and the growing number of authorities planning similar developments, it would seem useful to establish a 'user-group' to share good practices and ideas. Electronic Information Boards appear to be the latest and increasingly popular method of disseminating air quality information to the public as they already exist in many town centres and can be integrated easily into AQM systems. However, only authorities with real-time analysers can adequately provide the public with up-to-date (hourly) information for their area.

Many of the authorities communicating hourly air quality information to the public also ensure that when air quality is poor, or forecast to be poor, the message does reach as many people as possible. They usually do this by follow-up telephone calls to local newspapers, radio and television since these also provide opportunities for interviews to be conducted (with health advice being included as well as requests for voluntary reductions in the use of private vehicles during the period of poor air quality).

5. Do you attempt to forecast air quality in any way?

***Yes – 9:** Simple predictions based on previous day's data, meteorological conditions and local knowledge (Birmingham, Leicester, Middlesbrough, Oxford, Rotherham, Walsall, Plymouth – internal predictions only); Bristol (work in progress with the Meteorological Office to develop a simple meteorological-based model); and Coventry (simple prediction using meteorological data but a computer model is being developed currently with a meteorological station to predict episodes of poor or moderate air quality).*

No – 76.

This shows that there is little sophistication employed currently in forecasting air quality on a day-to-day basis mainly because of the lack of suitable models and expertise amongst local authority staff. Local 'historical' knowledge seems to be the predominant basis for determining forecasts. If short-term air quality management is to be implemented effectively and if it is to involve the banning of vehicles from city centres during episodes of poor air quality, or when such episodes are forecast, considerable improvements in air quality forecasts will be needed.

6. Have you experienced any days when the air quality is 'very poor'(as described by the DoE bandings)?

Yes – 11: *O_3 (Bristol, Leicester, Portsmouth, Southampton, Norwich – on a regional basis); SO_2 (Belfast, Sheffield, Leeds – 402 ppb); NO_2 (Bath, Brighton, Bristol, Manchester).*

No – 32.

Don't Know – 41 *(due to a lack of hourly monitoring).*

These answers highlight the limitations of the monitoring in the UK since many authorities are unaware if they have experienced periods of 'very poor' air quality or not, due to limited (hourly) monitoring capabilities. Nevertheless, 11 out of 43 (26%) of the definite responses indicated they had experienced very poor air quality. In reality, this number is likely to be much higher since many of the 'no' responses should have been 'don't know' as the authorities do not possess monitors to measure hourly concentrations.

7. Do you issue health advice to the public on the basis of your monitoring (e.g. pollution/smog alerts)? If yes, on what criteria is this based (eg DoE, WHO)?

Yes – 17: *Based on DoE (13), WHO (6), EC (2), own criteria (Bristol, Rotherham). Means of disseminating advice: Brighton (based on DoE criteria - leaflet and via local hospital); Leicester (details of episodes passed to the Community Health Officer in the Area Health Authority to provide advice); Middlesbrough (issued with daily faxes, general information); and Sheffield (DoE based, supplemented by information from local Public Health Department).*

No – 67.

Plans to do so: *Norwich (Health Alert System for ozone from May 1995 organised by the Air Quality and Health Action Group) and Plymouth.*

Only one-fifth of authorities issue health advice. Even though local monitoring stations often provide very different results compared with the national EUN stations, the national pollution alerts and associated health advice are based on the latter. Clearly there is a need for closer cooperation between central and local government to avoid unnecessary confusion amongst the public.

8. Is any request made to the public not to use vehicles, delay journeys unless essential, when the air quality is poor?

Yes – 9: *Bristol (through press releases to media); Coventry (through radio and newspaper); Middlesbrough (ad-hoc basis, advice to asthmatics); Rotherham (through radio request); Sheffield (media broadcast 'poor' air quality with message); Doncaster (via media); Leeds (statement made by Environment Committee); Leicester (as part of press articles and interviews) and Norwich (Health Alert System for ozone from May 1995).*

No – 75.

Very few local authorities (11%) issue advice about how the public can help reduce pollution during episodes (and these do not include all the authorities who have experienced 'very poor' air quality in the last few years). If vehicle exhausts are the

principal source of the pollutant responsible for poor air quality locally, requests for voluntary action by motorists to minimise the use of their vehicles and to use public transport instead ought to be issued along with health advice during pollution episodes.

9. Do you think local authorities should be given the power to introduce short-term traffic restrictions during periods of poor air quality? If yes, what restrictive measures/powers would you favour?

Yes – 55; No – 12; possibly – 4; no response – 13.

This is a controversial question, one which central government subsequently stated as being under consideration[5]. The answers to this question should be considered as personal opinions expressed by the respondents and not the official view of the local authority. Overall, 55 out of 71 (78%) who gave a response expressed a view favouring this action during periods of poor air quality. In general, favoured measures include placing a restriction on the number and type of vehicles entering the central urban area, with mandatory use of park-and-ride schemes and traffic signal control. Implementation of such measures needs to be based on the results provided by a monitoring network which can assess the seriousness and spatial dimensions of the air quality problem, and a modelling capability which can suggest how these restrictions are likely to affect air quality.

Details of the responses favouring vehicle restrictions and/or priority being given to public transport during such episodes: *restrict vehicles from town/city centre (18); restrict number and type of vehicles entering the area (2); prohibit vehicles from town centre trouble spots during rush hours; only allow vehicles with catalysts into city centre – redirect other vehicles to outer city park-and-ride or public transport etc; restriction of vehicles in certain areas only – requires an integrated approach comprising police and adjacent local authorities. Short-term bans could only be used where alternative routes exist and only for small sections of the road, e.g. town centre road. Advance warning with automatic diversion signals would be necessary; temporary traffic management plans; close certain busy roads with commonly stationary traffic; control traffic lights into the city; temporarily increase parking charges and introduce restrictions for private vehicles; town centre commercial vitality concerns, but a good idea; would favour voluntary persuasion (at current pollution levels) duty on local authority (and allocation of resources) where air quality indicates action is appropriate, any compulsory restrictive powers would need to be part of an approved air quality management plan; severely curtail access to city centres but there would be practical difficulties of supplying perimeter parking places and suitable alternative transport; only allow vehicles with odd/even registrations into the city on alternate days; if poor NO_2 in towns then re-route; public transport priority using traffic signal control together with increased publicity given to the air quality impact of using cars during such times; mandatory use of park-and-ride schemes (3); need to determine air quality management plan for the area, including neighbouring districts, so that a joint strategy can be agreed. Initially any restriction should be voluntary, but if unsuccessful then mandatory re-routing away from polluted areas.*

Responses indicating reluctance to impose traffic bans include: *greater emphasis needed on long-term strategies for an integrated transport system; results of monitoring*

indicate that this would be unlikely in this area (Bournemouth); prefer a pay-as-you-go system in city centre; although this authority is sympathetic to the notion of short-term measures to combat periods of poor air quality, more proactive rather than reactive measures would be preferred.

Responses which expressed concern whether a temporary ban could be achieved and/or be effective include: *the ability to close off sections of the inner city to all but public transport must be linked to greater monitoring capabilities; power can only be exercised if real-time data is available for the local area (3); central government policy would no doubt govern this – do we envisage the situation becoming similar to Athens where cars are used on alternate days?; our experience is that we receive much pollution from outside our area e.g. ozone from continental Europe. Thus local measures may be of limited effect – question is difficult to answer; who would enforce the closure of M5/M6 through Sandwell on days of poor air quality?; unsure as to how it could be achieved (2).*

One other issue raised by a response: *persuade motorists to switch off engines at traffic lights during smog events.*

10. Have you assessed the air quality changes associated with any of the following road transport schemes (i.e. undertaken before-and-after pollution monitoring)?

a) Traffic calming in residential areas (e.g. 20 mph zones, road narrowings, speed humps)?

Yes – 1: *Edinburgh (NO_2 diffusion tubes located to assess the benefits of traffic management, known as the Lothian Green Scheme).*

No – 67.

Plans to do so – 16: *Aberdeen, Bath, Brighton, Cardiff, Exeter, Leicester, Newcastle, Northampton, Norwich, Peterborough, Plymouth, Reading, Southampton, Stockton-on-Tees, Stockport, York.*

b) Pedestrian-only areas/car-free zones in the town centre/shopping areas?

Yes – 13: *Birmingham; Brighton (no significant difference recorded, cars reduced but buses increased); Bristol; Bournemouth; Darlington; Derby; Edinburgh; Huddersfield; Leeds; Oxford (monthly NO_2 tubes city-wide before the implementation of the Oxford Transport Strategy); Reading; Sheffield; Wolverhampton.*

No – 62.

Plans to do so – 9: *Bath, Cheltenham, Doncaster, Gloucester, Maidstone, Newcastle, Northampton, Norwich, Stockton-on-Tees.*

c) Public transport priority measures (e.g. bus lanes)?

Yes – 7: *Birmingham (pre-improvement survey of shopping area subject to traffic calming and bus lanes); Glasgow (Argyle Street Bridge – NO_2 and CO measured before and after local bus station re-located, concentrations of both pollutants were reduced); Leeds (in process of obtaining 'before' information for 'guided bus'); Liverpool ('Smart Bus' scheme and ordinary operator routes); Sheffield (as part of other schemes); and Walsall (traffic management scheme led to busy road with more buses).*

No – 66.

Plans to do so – 11: *Aberdeen; Brighton; Cardiff; Huddersfield; Maidstone (MIST project involving a reduction in private commuter car traffic of 15% and an increase in the public share of the travel market to 20%); Newcastle; Northampton; Norwich; Oldham; Stockton-on-Tees; Winchester.*

d) Park-and-ride schemes (daily or occasional)?

Yes – 3: *Bristol (Avon County Council monitoring); Cheltenham (one scheme established, a second identified); and Leeds (in process of obtaining 'before' data).*

No – 72.

Plans to do so – 9: *Aberdeen; Huddersfield; Maidstone (MIST project – TRL producing model); Northampton; Norwich; Reading; Tunbridge Wells; York.*

e) Low- or zero-emission public transport vehicles (e.g. electric vehicles, light rapid transport systems)?

Yes – 3: *Bath (trial of two LPG Buses and one NGV van); Liverpool (piloted a 'Smart Bus' scheme with low-emission vehicles operating a rapid transport system on varied routes); and Middlesbrough (piloting a small fleet of cars powered by compressed natural gas).*

No – 76.

Plans to do so – 5: *Leeds (in advance of the Leeds Supertram scheme); Northampton; Peterborough; Stockton-on-Tees (Light Rapid Transport system for Cleveland); and Tunbridge Wells (LRT).*

f) Other schemes (e.g. HGV restricted routes, bypasses, red routes)?

Yes – 8: *Colchester (construction of major road alterations); Crawley (proposed new M23 junction near new housing estate); Darlington (new by-pass effect on residential areas); Leeds (as part of other schemes); Leicester (Siemens/Nottingham University initiative with traffic management control); Manchester (before and after monitoring of current widening of the M56); Oldham (lead and SO2 monitoring associated with improvement of primary route A62 in connection with M66); and Salford (modelling of pollutants).*

No – 68.

Plans to do so – 8: *Aberdeen, Newport, Cardiff, Gillingham, Newcastle, Northampton, Sheffield, Stockton-on-Tees.*

The extent of monitoring undertaken (e.g. number of monitors, type of pollutants measured, length of monitoring period) to assess the air quality changes associated with the various schemes listed in response to questions 10a to 10f have not been examined in detail. Some of the proposed road transport schemes are wide-ranging and will require considerable monitoring and modelling work to assess the likely spatial and temporal air quality improvements. For example, Oxford is introducing the Oxford Transport Strategy which includes new bus lanes, increased pedestrianisation, more low emission vehicles (four electric buses operate currently), expanded park-and-ride facilities and a proposed guided transit expressway.

If local authorities are to select planning and transport measures applicable to their own air quality problems, so as to achieve the national air quality targets likely to be set

by government, it is vital that evidence becomes available to indicate the likely effectiveness of a wide range of such measures. Many more before-and-after monitoring exercises, combined with modelling studies, are needed across the country to be able to assess fully the temporal and spatial changes in pollution concentrations that result from various emission-reduction measures[6]. Far too few such exercises have been undertaken to date.

11. Do you use any modelling techniques for long-term air quality planning (i.e. have you attempted to predict the likely air quality changes associated with proposed land-use planning or road transport policies e.g. park-and-ride, road pricing)?

Yes – 4: *Bristol (Bristol Integrated Transport and Environment Study, BRITES, survey for Avon County Council); Birmingham and Oxford (air quality assessment using the DoT Design Manual for Roads and Bridges); and Darlington (prediction attempted on the effects of a new by-pass on nearby residential properties).*

No – 64.

Plans to do so – 16: *Cardiff; Chelmsford; Exeter; Huddersfield (Kirklees LIFE funding with Berlin, Copenhagen and Madrid for the Integrated System for Implementing Sustainability, ISIS, project); Maidstone (MIST project developing model of pollutants over A20 corridor and future developments); Newcastle (currently considering use of Indic Airviro) Northampton; Norwich; Plymouth; Reading; Rotherham; Sheffield; Stockport; Stockton-on-Tees; Warrington; and York.*

Modelling requires cooperation between planning, transport and environmental health departments of local government. Given the cost of such models, the staff training required and because pollutants are transferred across local authority boundaries it would seem appropriate for neighbouring local authorities to cooperate in modelling studies.

In addition to the models frequently used for major point industrial sources (e.g. US EPA Industrial Source Complex models) and for roads (e.g. DoT Design Manual for Roads and Bridges, the US CALINE4 and The Netherlands CAR model), the models which offer most potential for urban-wide modelling are the Swedish-developed Indic Airviro model and the UK Atmospheric Dispersion Modelling System (ADMS)[7]. Whereas the Indic Airviro model has been available for several years the ADMS is still being developed but it should mean that within a year or so local authorities will have a choice of modelling systems which can provide a suite of models applicable to local air quality management[8,9].

12. Do you have any short-term or long-term plans to develop your air quality management activities further?

Yes – 72: Developments are wide-ranging and have been grouped according to the air quality management system components (although some local authorities are active in several of these components):

a. Monitoring activities - 63: 40 plan to install real-time analyses (e.g. EUN-compatible sites for Aberdeen, Manchester, Oxford, Norwich, Stockport, Wolverhampton) including 16 additional PM_{10} and 2 $PM_{2.5}$ analysers; 9 intend to introduce or increase the use of NO_2

diffusion tubes; 2 to introduce benzene diffusion tubes (Gloucester, Norwich); 2 to purchase mobile monitoring systems (e.g. equivalent to an EUN Phase I station in the case of Edinburgh); and 3 to install Opsis equipment (Bradford, Chester, York). Such activities usually involve data collection and processing improvements too (e.g. Liverpool updating its software for access to EUN data).

b. Dissemination of pollution details to the public – 28: 8 to install Public Display screens/Electronic Information Boards (e.g. Brighton will use sponsorship of moving message board by local companies); 4 to prepare annual air quality reports (seen as the first stage of an AQM plan); 2 to introduce smog alerts (Stoke-on-Trent and Walsall); 4 to apply DoE Air Quality Bands and 9 to issue air quality forecasts.

c. Emissions inventories – 16: Bath, Bristol, Chelmsford, Cheltenham, Coventry, Dudley, Hartlepool, Huddersfield, Middlesbrough, Newcastle, Norwich, Sunderland, South Tyneside, St. Helens, Wolverhampton.

d. Modelling – 14: Birmingham (to assist in traffic management and clarifying health effects); Cardiff (long-term modelling with computer package involving air pollution and meteorological data); Coventry (forecasting with Weather Centre for smog episodes); Huddersfield (ISIS long-term modelling project); Maidstone (MIST project); and Newcastle (Indic Airviro).

e. Air Quality Management Initiatives (including creation of Air Quality Management Areas) – 12: Birmingham and Dudley (West Midlands Monitoring Network); Gateshead, Newcastle and Southshields/South Tyneside (5 authorities forming a regional air quality management strategy group within Tyne-and-Wear); Rotherham and Sheffield Air Quality Management Initiative; Stockport (AQM involving Environmental Health, Planning and Transport departments); Stockton-on-Tees and Hartlepool (The Cleveland AQM plan involving 4 borough councils); Warrington (feasibility study for an AQM plan) and Wigan (Air Quality Base Line Study commissioned).

f. Integrated Transport Policy (road transport strategies incorporating air quality factors) – 15: Cheltenham (reduce town centre vehicle use and de-trunk the A40, currently through the town); Huddersfield (ISIS project); Luton (M1 widening, involving automated monitoring); Maidstone (MIST project); and Norwich (Norwich Area Transportation Strategy).

g. Research projects – 6: Cardiff (EPSRC 'cities and sustainability' project with Cardiff University); Leicester (Siemens/Nottingham University traffic management control scheme, study of air quality near schools in city suburbs – linked to health authority study of related asthma – and analysis of real-time analyser filters for PAHs); Luton (study to establish correlation with respiratory health episodes to derive a predictive model); Stockton-on-Tees (modelling techniques and re-assessment of earlier monitoring); Swansea (local study of effects of air quality on the epidemiology of asthma); and Winchester (Investigating use of Siemens/DoE roadside monitor/traffic control systems).

***No immediate plans – 11**: Belfast, Birkenhead, Blackburn, Dundee, Edinburgh, Great Grimsby, Ipswich, Rugby, Salford, Southampton, Sunderland. **No Response – 1**: Newport.*

Only 11 out of 83 (13%) authorities do not have any air quality management plans currently. In contrast, 63 out of 83 (76%) have plans to extend their monitoring facilities and two-thirds of these specify that this will be continuous real-time monitoring (with 6 cities intending EUN site status). Measuring PM_{10}, NO_x and O_3 are the major priorities either using fixed analysers (including Opsis) or mobile units. The important task of disseminating daily air quality information to the public is receiving greater attention with 28 authorities having plans to do this (although only Stoke-on-Trent and Walsall specify that this will include smog alerts during local pollution episodes). The need to compile emission inventories, introduce air quality modelling, cooperate in establishing Air Quality Management Areas and to integrate air quality considerations into transport schemes, are amongst many initiatives planned or underway concerning the development of local air quality management systems. However, limits on funding remain the key problem[10]. For example, 19 authorities stressed that implementation of their plans depended upon the success of their funding applications (e.g. Coventry's bid to DoE involving monitoring and an emissions inventory). A survey by the Chartered Institute of Environmental Health (CIEH) found that 85% of local authorities want air quality monitoring to be made a statutory duty since this would lead to an increase in the resources allocated to environmental management[11].

Conclusion

This local authority survey, highlighting the situation in late 1994 as well as the plans existing at that time, indicates that most environmental health departments are very active in trying to develop air quality management systems but progress and the scale of future plans vary considerably. Considering the first step towards developing local air quality management, namely that of establishing real-time automatic analysers to assess whether an air quality problem exists, some authorities do now have a useful network of such monitors whereas other authorities have none. The CIEH claims that fewer than half of the authorities that want to expand their monitoring operations are able to do so[11]. Most local authority plans are hampered by very limited resources, the absence of a nationally agreed framework for improving local air quality, and the lack of legislative powers which would enable local authorities to be able to tackle any air quality problems that they find, especially those due to vehicle emissions. In January 1995, soon after this survey was conducted, the possibilities of overcoming these problems improved when the government outlined new approaches to assessing and managing local air quality which are intended to provide the direction for a detailed strategy to be finalised later in the year[5]. Local authorities are promised a central role in air quality management, including new powers and duties. However, as frequently pointed out by local authorities (as well as the NSCA) they will require increased resources (finance for equipment, new staff, training) in addition to the promised guidance, national coordination and legislative powers if local air quality management is to become effective across the country.

References

1. NSCA (1993) Local authority air pollution monitoring: NSCA survey. *Clean Air*, 23(3), 121-129.

2. South East Institute of Public Health (1994) *Air Quality in London: First Report of the London Air Quality Network*. SEIPH: Tunbridge Wells.

3. South East Institute of Public Health (1995) *Air Quality in London: Second Report of the London Air Quality Network*. SEIPH: Tunbridge Wells.

4. QUARG (1993) *Urban Air Quality in the United Kingdom: First Report*. London: Department of the Environment.

5. UK Department of the Environment (1995) *Air Quality: Meeting the Challenge*. London: Department of the Environment.

6. Elsom DM (1994). The development of urban air quality management systems in the United Kingdom. In Baldasano JM, Brebbia CA, Power H and Zanetti P (eds) *Pollution Control and Monitoring*, volume 2, Southampton: Computational Mechanics Publications, 545-552.

7. Elsom DM (1995). Air and climate. In Morris P and Therivel R (eds) *Methods of Environmental Impact Assessment*, London: UCL Press, 120-142.

8. Beevers S and Carruthers D (1994). *The Urban Air Quality Management Toolkit*. Tunbridge Wells: South East Institute of Public Health.

9. Read S and Törnevik H (1995). *The Indic Airviro System Versus 'The Urban Air Quality Management Toolkit'*. Stroud: Enviro Technology Services.

10. Elsom DM and Crabbe H (1995). Developing effective urban air quality management systems in the United Kingdom: case studies. *Paper presented at the 10th World Clean Air Congress, Helsinki, May 1995.*

11. Maryon S (1994). Local authorities eager to tackle a pressing local problem. *Environmental Health*, August issue, 181-82.

Monitoring Capabilities: October-November 1994

Town/City			Manual			Automatic - Real Time									
	EUN Site	Opsis or Mobile equipment	NO2 Diffusion Tubes	SO2/ Smoke Samplers	Lead	NOx	O3	SO2	CO	PM10	PM2.5	T.S.P.	Benzene	Other VOCs	Other
Aberdeen			21	4											
Basildon															B+K
Bath			12	1		2		1	2						
Belfast	I+II		8			1	1	2	1	1			1	1	
Birkenhead			9	5	1										
Birmingham	I+II,I	M	20	3	3	5	3	5	3	4	1	1	1	1	G, 15 BDT
Blackburn			5												
Blackpool			4	1											G+BR
Bolton			7	4	4										2 NH3 DT, B CB
Bournemouth			14												G
Bradford			25	6	5				1						
Brighton			21			1	1								
Bristol	I+II	M	56	6	3	4	2	3	3	2		1	1	1	4-fluorides
Cambridge			34			2	2		2						
Cardiff	I+II	O	26	3	1	2	2	2	1	1			2(*1+1)	1	1-Cadmium
Chelmsford			4	2	2										
Cheltenham			5		1										
Chester			10	4	1										
Colchester			10	1											
Coventry		O	4			1	1	1					*1	*1	
Crawley			8	1											G, 1 B+K
Darlington			4	1											
Derby		M	4	1		1	1								
Doncaster		O	4	4		2	2	2	1				*1		
Dudley			4	1	1	1	1	1	1						HM
Dundee			5												
Durham			5	1											
Eastbourne			4	1											
Edinburgh	I+II		16	2		1	1	1	1	1			1	1	
Exeter			17	2											3 DG
Gateshead			39	1											3 G
Gillingham			8												
Glasgow			16	9	9	1			1						2 G, 12 BS
Gloucester			4	1	1										HM
Grimsby			4	1											
Hartlepool			4	1											
Huddersfield			28	7		2	1	1				4			20 CB (BTX)
Ipswich			No pollutants monitored												
Kingston Upon Hull	I		12	5	1	1	1	1	1	1					HM
Leeds	I+II		35	6	4	2	1	1	1	2			1	1	1 MES
Leicester	I	M	10	4		2	2	2	2	2					
Lincoln			4	3											1-pollen
Liverpool	I		35	3	6	1	1	1	1	1					
Luton			37	1					1						6-O3 DT, 6 BDT
Maidstone		O	4	1		1	1	1					*1	*1-X,T	
Manchester			10	7	1	1	1	1	1						CB(B), weekly PM10
Middlesbrough	II		yes	1		1	1	1	1	1			1	1	TOMPs,BXT DT
Newcastle upon Tyne	I	O	40	6	5	1	2	2	1	1		1	*1	*1-T	HCl
Newport			5	4											4 DG
Northampton			10	1											3 RD

Town/City	EUN Site	Opsis or Mobile equipment	Manual: NO2 Diffusion Tubes	Manual: SO2/ Smoke Samplers	Manual: Lead	Automatic - Real Time: NOx	O3	SO2	CO	PM10	PM2.5	T.S.P.	Benzene	Other VOCs	Other
Norwich			11	7	4	1									
Nottingham			No information received												
Oldham			6	6	5										AR, NH3, G
Oxford			40	1	2	1	1	1	1	1					
Paisley			10	2											
Peterborough			10	1											4 G
Plymouth				1		1	1	2							1 B+K
Poole			No information received												
Portsmouth		M	6	1	2	1	1		1						
Preston			5	1											
Reading			yes		yes										CO DT
Rochdale			No information received												
Rotherham			12	4		2	1	3		1					
Rugby			4	3											
Salford		M	9	1	4	1	1	1	1	1			1	1	MS, AR, NH3, G, HM
Sandwell			7	3	6	1	1	1	1	1					5 BDT
Sheffield		O		1		3	2	2	2			1	*1	*1- X,T	MS
Slough			4	1											
Southampton	I		5			2	2	2	1	1					
Southend-on-sea			No pollutants measured on a regular basis												
Southport			13	2											
Southsheilds			10	3											8 B CB, DG
St Helens			4	2											
Stevenage			No information received												
Stockport			4	1											
Stockton-on-Tees			5		5	2	2	2							5 HC DT, HM, NH3,G
Stoke on Trent				3											
Sunderland				6				1				6			
Swansea			5	2		1	1	1	1	1		2			1 B+K
Swindon			4	1											
Tunbridge Wells			12	4											(past Opsis survey)
Walsall		M	5	1	yes	1	1	1	1 (mobile)						VOC DT
Warrington			9	5	5										2 NH3 DT, 2 DG
Wigan			7	4	6										AR. 5-Fluorides
Winchester			6												
Wolverhampton			26	6	5							5			
Worthing			4												G
York			6	2											

Key to codes

* = indicates measured by Opsis
M= Mobile
O= Opsis
B= Benzene
X= Xylene
T= Toluene
G= Gamma Radiation
BR= Beta Radiation

CB= Carbon Badges
DT= Diffusion Tubes
AR= Acid Rain
NH3= Ammonia
MS= Meteorological Station
HC= Hydrocarbons
HM= Heavy Metals

DG= Deposit Gauge (grit & dust)
BS= Black Smoke filters
MES= Multi-Element Survey
RD= Radiation Dosimeters

B+K= A Bruel and Kjaer 1302 Gas Analyser measuring the standard pollutants (NOx, O3,SO2,CO, CO2, HC)

EVALUATING ENVIRONMENTAL EFFECTS AS PART OF AN ENVIRONMENTAL MANAGEMENT SYSTEM

D.J.A Brown
Environmental Management Consultant

(David Brown recently assisted the NSCA, in collaboration with the Department of the Environment, with the organisation of a workshop for NGOs on the European Community "Eco-Management and Audit" (EMA) Scheme. This paper is based on the presentation he made at the workshop.

1 Introduction

"Environmental Management" is really not a recent phenomenon. Any organisation that has, at any time in the past, been subjected to environmental regulations or consent conditions will have had to "manage" their environmental performance with respect to this regulated issue. Of course, some, if not many, organisations may not have been aware that they had a system whereby this issue was managed (an Environmental Management System – EMS), but it cannot be purely by chance that the number of failures to comply with the regulations has been a relatively small percentage of the total number to whom consents have applied.

However, organisations are now being given the opportunity to change from these relatively informal systems to more formal (not necessarily more bureaucratic) systems that can be accredited to an acceptable and published standard. Such accreditation can give confidence to all the interested parties, both inside and outside the organisation, that all environmental effects associated with its activities, and the risks and liabilities associated with these, are being minimised in a cost-effective way. Hence both the environment and the organisation benefit.

Currently, there are two published Standards – the British Standard Specification for Environmental Management Systems (BS 7750: 1994) and the European Community Eco-Management and Audit (EMA) Regulation (1836/93). The central principle behind both initiatives is one of self regulation and consequently both are voluntary. The management system component of both is essentially the same, the major difference being that EMA requires the publication of verified environmental statements at certain specified times during the implementation of the system, whereas such statements are not a requirement of BS 7750. There are also different coverages in use. BS 7750 applies to any organisation, irrespective of sector and to the whole organisation, whereas the EMA scheme is restricted to the manufacturing, quarrying, mining, energy, waste and recycling sectors, and is implemented at site level only. In the UK (uniquely among European countries) the EMA scheme has been extended to include local authorities.

Specifications for some types of management systems other than environmental ones, such as Quality Management Systems (QMSs) have, of course been in existence for a long time (e.g. BS 5750 and the associated international ISO 9000). Not surprisingly, because a management system is a management system largely irrespective of the issue that is being managed, in principle there is little difference between QMS and EMS specifications, with, however, one important major exception. With a QMS it is up to the

customer to specify the quality level to which a product must conform. But the customer in an EMS is the environment and, as such, is unable to speak for itself. With an EMS therefore, the Standards themselves have to define the "quality level", or performance requirements. Basically, these performance requirements are *compliance with all relevant legislative and regulatory requirements and a commitment to continual improvement in line with the organisation's policy based on an* ***evaluation of its environmental effects.*** Thus the component of an EMS known as the "Environmental Effects Evaluation" (EEE) is that which is unique to environmental, as opposed to any other, management systems, and is considered by many as one of, if not *the*, most crucial part of any EMS.

EEE can therefore be defined as the process of identifying the areas of activity of an organisation which are having, or have the potential to have, significant effects upon the environment, and where action is most necessary to reduce the risks to both the organisation and the environment. Thus the output from an EEE procedure will be a "Register of Significant Environmental Effects".

2 What is an "Environmental Effect"?

An effect upon the environment can be said to occur as a result of an activity if either:

(a) Pollution and/or waste is produced at a rate greater than that at which it can be recycled, absorbed or otherwise rendered harmless by the environment; or

(b) The activity in itself alters the physical condition of the environment to a harmful extent; or

(c) A renewable resource is used at a rate greater than that at which it can be generated;

(d) A non-renewable resource is used at a rate greater than that at which a renewable resource, used sustainably, can be substituted for it.

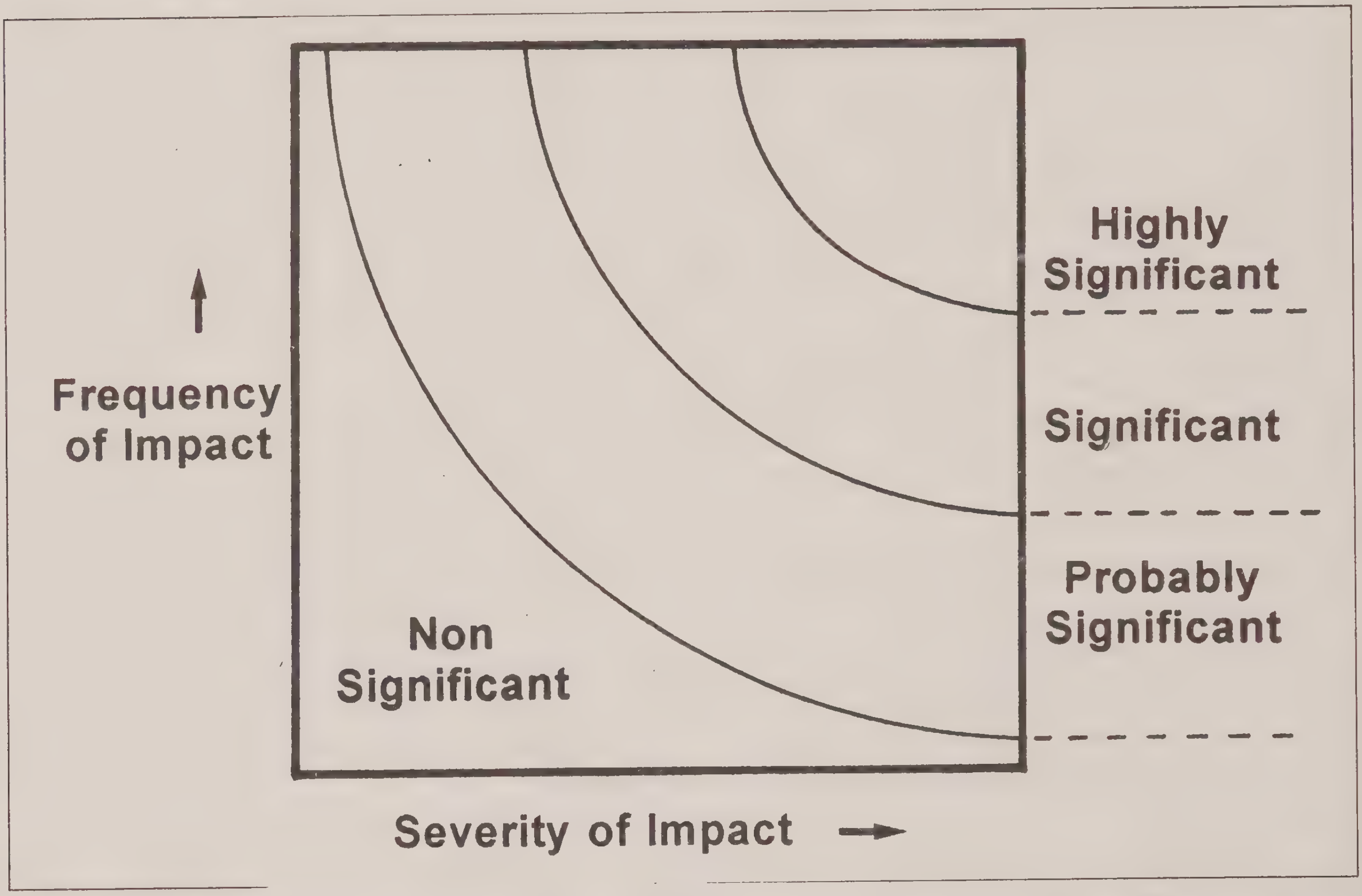
The major generic inputs to any site are water, energy raw materials and other resources. As a result of the storage and/or usage of these inputs in the various processes on site, in addition to the product leaving the site, the chances are that waste and/or pollution will also be produced. Dependent upon where this pollution/waste is discharged, it will almost certainly alter the quality of either the surface water and/or the groundwater, the air and/or the amenity (noise, vibration), and/or the land and/or landscape. The environmental effects associated with these quality alterations can be described as "direct", but because one organisation's product usually becomes another's resource, there are often upstream "indirect" effects associated with the inputs to the process (which may involve renewable and non-renewable resources), and those downstream associated with the use of the product.

3 What Makes an Environmental Effect "Significant"?

Basically, there are two major components to the testing of the environmental significance of the direct effect of a particular activity or substance. One is the "frequency" with which the environment is affected by that activity, or receives an input of that substance; and the second is the environmental "impact" of that activity or substance when it occurs or is released. Thus, as is shown diagrammatically in Figure 1, a substance that is released with a high frequency, and has a high impact when it is released must be regarded as "highly

significant". Conversely, a substance which can never find its way into the environment is on the horizontal axis (zero frequency) and a totally benign substance is on the vertical axis (zero impact). In both these cases, the substance should be regarded as "non-significant". In between highly and non-significant are somewhat arbitrary bands of "significance" and "probable significance".

Figure 1: The Major Determinands of Environmental Significance

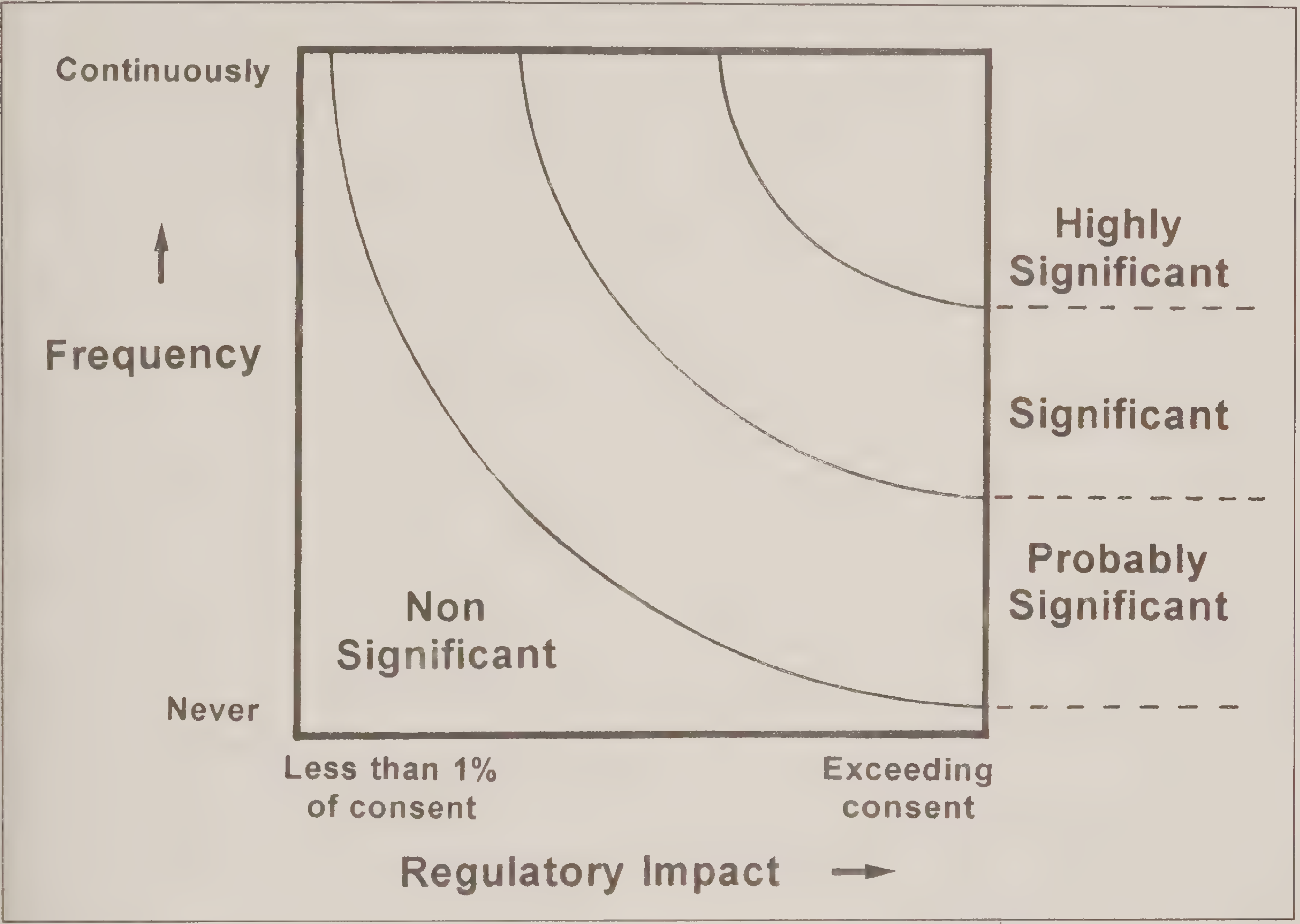


Various approaches can be used to decide where on the "frequency" and "impact" axes any particular issue falls. They range from, most commonly, the fairly straightforward but possibly inconsistent use of "Expert Judgement", through the use of "Questionnaires" with yes/no answers, and "Ranking Systems" using categories of high/medium/low, through to "Scoring Systems" whereby numbers from say 0-5 are ascribed according to a pre-described condition.

Whichever system is used, determining where an activity or substance falls on the "Frequency" axis is fairly straightforward – "Continuously" is at the top, "Never" is at the bottom (see Figure 2) and, in a scoring system, in between would be various time intervals such as "Daily", "Weekly", "Annually" etc.

The "Impact" axis is, perhaps, a little more complex, in that there are several ways in which the impact can be assessed. Firstly, for a regulated substance, there is the obvious measure of "Regulatory Impact". "Exceeding the consent value" would be at the right, and "Less than 1% of the consent" could be at the left (Figure 2). In a scoring system, various other percentages of the consent value would be in between.

Figure 2: Measures of Frequency and Regulatory Impact



But what about other measures of impact? Both BS 7750 and the EMA scheme encourage organisations to go beyond regulatory compliance, so what other criteria could be used? Included amongst them could be such measures as:

(a) **Environmental Impact**: i.e. the resulting environmental concentration relative to some accepted environmental damage threshold.

(b) **Significance and Extent of Receptor**: i.e. is the damage of local, national or international significance?

(c) **Longevity and Reversibility of Impact**: i.e. the permanence and/or recovery time of the damaged ecosystem component.

(d) **Sensitivity of the Press and Public to the Impact**: i.e. the extent of local and general public concern.

(e) **Impact Relative to Sustainable Development**: i.e. the extent to which the activity is truly sustainable.

(f) **Business Significance of Impact**: i.e. the impact on the business of any damage. (Strictly speaking, this final measure – business significance – is not relevant to an EEE. Nevertheless, any attempt to bring together business and environmental management is to be welcomed, and an assessment of the business significance at this stage may well assist with the cost/benefit analysis of any improvement that might be deemed necessary, at a later stage.)

For each of these measures of impact it is possible to draw up a scale to go along the bottom of Figure 1, so that the significance of the issue can be judged with respect to as many aspects of impact as possible.

4 Requirements of an EEE Procedure

Against this background to Environmental Management and what constitutes a significant environmental effect, the requirements for an EEE procedure specified within BS 7750 and the EMA Regulation will now be described.

The basic requirements for an EEE procedure are as follows: it should:

(a) cover the complete range of receptors
(b) cover the complete range of operations
(c) be systematic
(d) be documented
(e) produce a "register" of those regarded as significant
(f) be self consistent (even if subjective)
(g) demonstrate knowledge of regulations
(h) allow for comparison of severity of effects.

With regard to **(a)**, the range of receptors that should be considered include all the possible combinations of:

(i) **geographical extent**: e.g. local – regional – national – international;

(ii) **physical ecosystem components**: e.g.

air	– quality
	– amenity e.g. noise
land	– quality
	– landscape
water	– surface
	– ground;

(iii)**ecological ecosystem components**: e.g.

human	– organism
	– habitat
non-human	– organism
	– habitat.

With regard to **(b)**, the range of operations that should be considered include all possible combinations of:

(i) **temporal**: e.g. past – current – planned;

(ii) **direct and indirect operations**: e.g. indirect upstream – direct – indirect downstream;

(iii)**operating conditions**: e.g. normal – abnormal – emergency.

A word of explanation about these last three operating conditions. "Normal" operating conditions are those which pertain for most of the time. They are totally predictable, and occur with a high, or fairly high, frequency (e.g. continuously or daily). "Abnormal"

conditions are either (a) those which occur during exceptional but totally predictable circumstances such as start up of machinery or dredging of settlement lagoons, or (b) those for which the exact timing is less predictable, but which nevertheless are fairly certain to happen from time to time, such as during heavy rainfall. They occur less frequently than "normal" conditions, but can still be fairly frequent (e.g. daily or quarterly). "Emergency" conditions are those that should not happen, and for which the timing is totally unpredictable. They happen as a result of an accident (e.g. pipe fracture), plant failure (e.g. valve failure) or other exceptional circumstances (e.g. hurricane). They occur much less frequently, and their frequency is only estimable by risk analysis (e.g. once per lifetime of the site).

5 Specification for an EEE Procedure

The outline of an EEE system which satisfies the requirements of EMAS and BS 7750 is shown diagrammatically in Figure 3. The first stage will be a "Screening" phase which, as a result of a consideration of all the combinations of potential receptors and activities listed above, results in the publication of a register of "Relevant Issues". Each issue on this register is then subjected to "Tests of Significance" under normal and abnormal operating conditions, and/or "Analyses of Risk" under emergency conditions, using a "Frequency/Impact" analysis of the type described earlier. The results from these tests allow a "Register of Significant Issues" to be compiled. These issues are then prioritised for action, according to their position on the "Frequency/Impact" diagrams, with those nearest the top right hand corner being regarded as highest priority; as a result of this prioritisation the "Environmental Programme" is derived. A regular "Review" process checks that the "Tests" and "Analyses" are still current in the light of results from the "Programme", and less frequently, checks to see if the register of "Relevant Issues" is up-to-date, in the light of any new information such as changes in legislation.

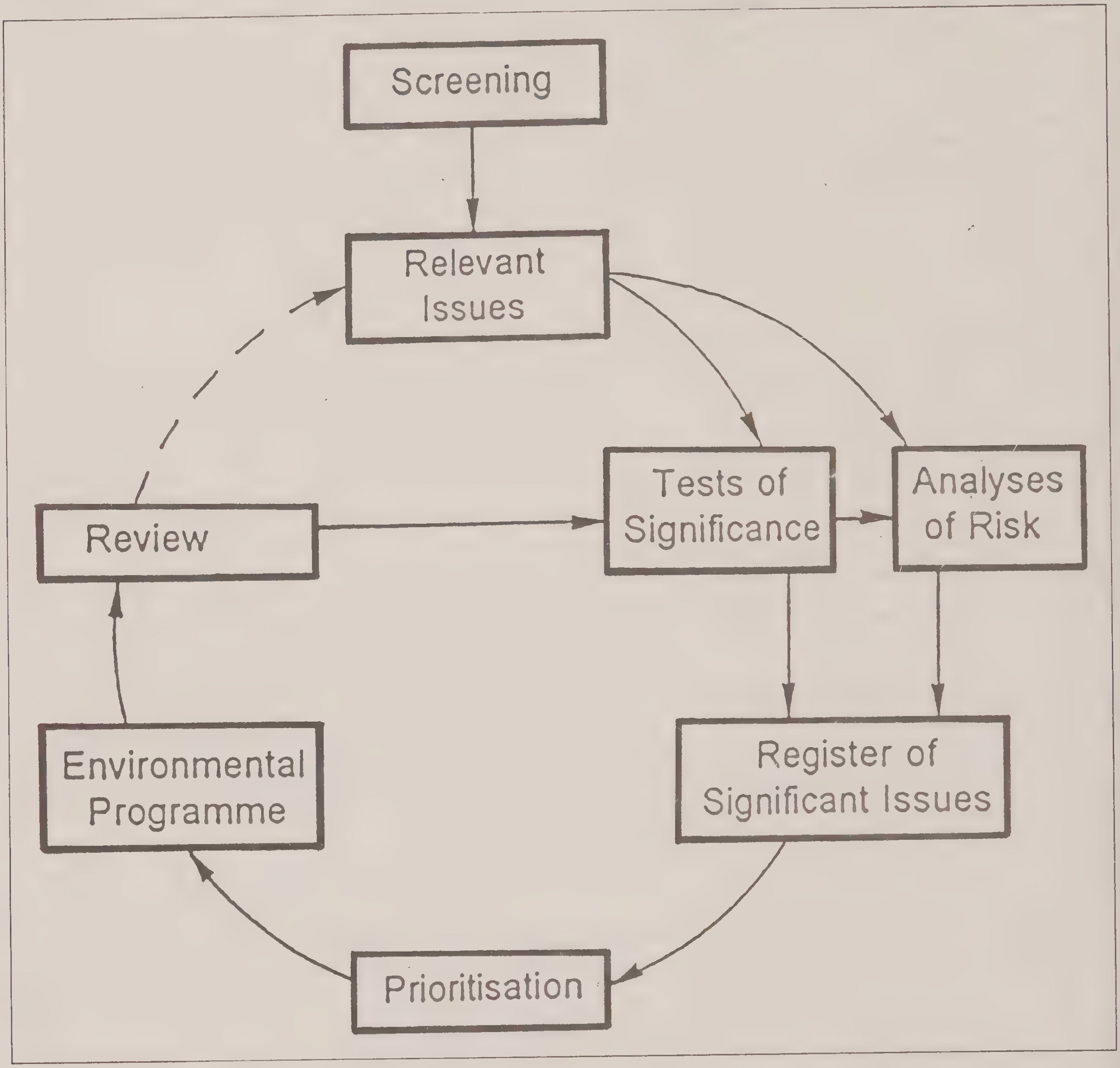
Strictly speaking, the production of the "Register of Significant Issues", with some indication of priority, represents the completion of the EEE procedure. However since there are feedbacks from the next component of an EMS – the "Environmental Programme" mentioned above – back into the EEE, this next stage needs to be described.

To ensure the issues identified as significant are managed, items on the "Register of Significant Issues" must also appear on one of the following:

- The Improvement Programme
- The Control Programme
- A Programme of Further Analysis/Measurement.

Those issues identified as being the highest priority for action will be placed on the "Improvement Programme". These are issues for which the status quo is not acceptable. The action could simply be, in some cases, increasing the frequency with which checks are made and writing instructions detailing what is required in the event of an observation outside the range normally acceptable. At the other extreme, installation of some complex control technology might be deemed necessary as the only way that the significance or risk could be reduced. A common feature for all items on the "Improvement Programme", however, is that quantitative targets need to be set for them which will lower significance, so that progress in achieving the improvement can be checked.

Figure 3: The Major Components of an EEE Procedure



Those issues regarded as lower priority should be placed on the "Control Programme". As such, they will have documentation associated with them which describes the responsibilities, and the frequency with which checks and measurements are necessary, for keeping the issue under control.

Some issues will be on the "Register of Significant Issues" because insufficient data were available to test their significance. These issues are placed on the "Programme of Further Analysis/Measurement". The programme for each issue, including timescales, should be defined and the results, when available, fed back into the EEE at the appropriate stage, and the significance testing process repeated.

The methodology described so far, of course, is primarily directed towards the "direct" environmental effects. The approach with regard to "Indirect" effects is the same with the exception that the two components of significance in these cases can be firstly the extent

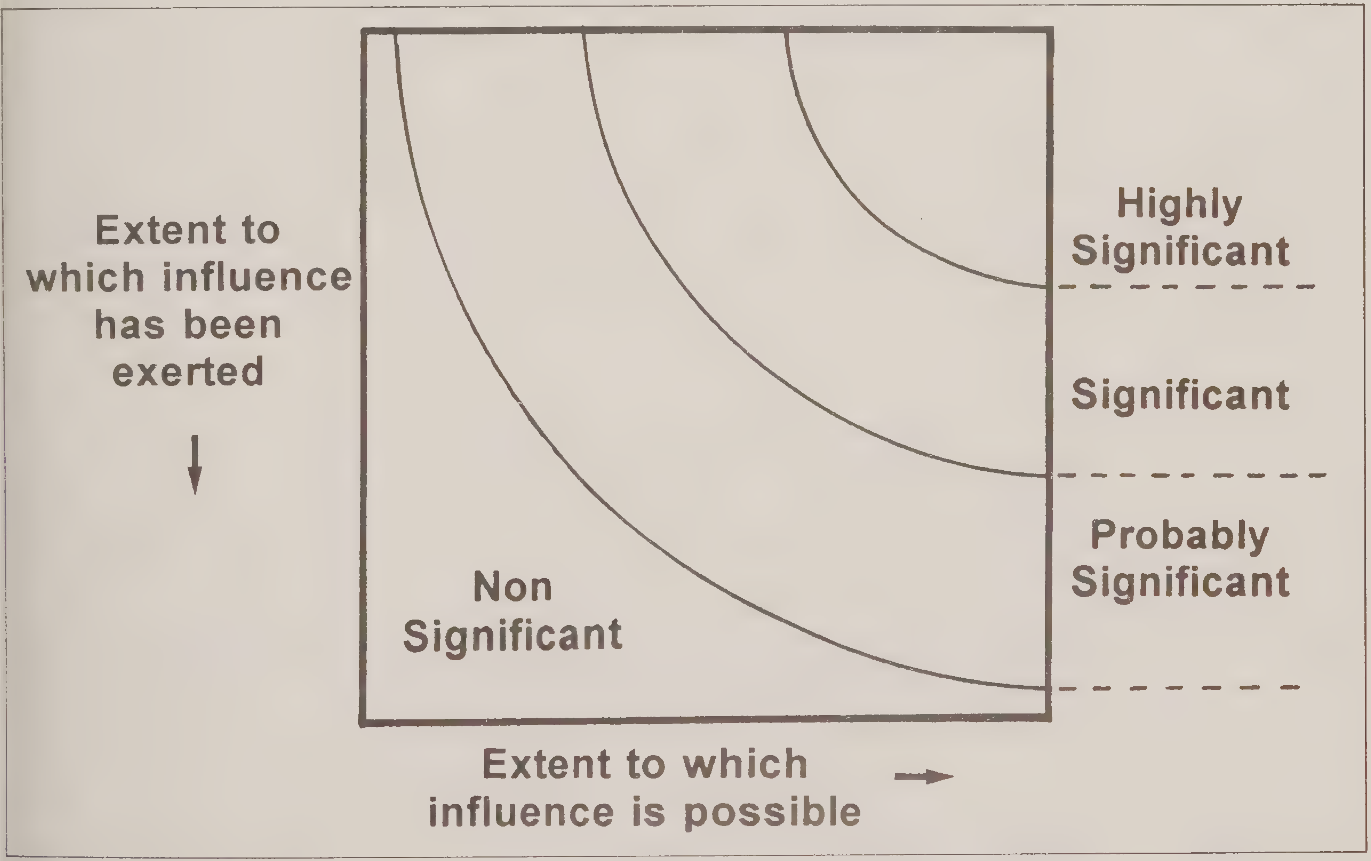
to which the organisation is in a position to influence either the quantities of, or the environmental effects associated with these upstream or downstream issues; and secondly the extent to which it has cost-effective plans in place to exert this influence (Figure 4).

Indirect effects identified as significant are placed on the Register, prioritised and allocated to the components of the Environmental Programme in the way previously described for the direct effects.

6 Conclusion

An Environmental Programme based on an EEE procedure specified in this paper will thereby be based on putting right the areas of activity of the organisation that are nearest the top right hand corner of the diagrams shown in Figures 1 and 4. Thus those issues which are having, or have the potential to have, the most significant effects upon the environment (in other words, the ones posing the greatest risks to both the organisation and the environment) will be tackled first; having corrected these issues, the ones next in line come to the top of the list and are acted upon. In this way, one of the major objectives of implementing an EMS – ensuring continual environmental improvement – will be achieved.

Figure 4: Testing for Significance of Indirect Effects



BOOKS AND REPORTS

A GUIDE TO RISK ASSESSMENT AND RISK MANAGEMENT FOR ENVIRONMENTAL PROTECTION

Department of the Environment. HMSO, 1995. £9.95. ISBN 0 11 753091 3.

An authoritative statement of the underlying principles of assessing environmental risks including an invaluable clarification of the precautionary principle. Although intended for public sector policy makers, it will be of value to a much wider audience.

LANDFILL GAS FROM CLOSED SITES IN COVENTRY AND WARWICKSHIRE

Warwickshire Environmental Protection Council (WEPC), 1995. £35. ISBN 0 9525686 0 8. Copies available from EH Division, Community Services Dept, Nuneaton & Bedworth BC, Coton Road, Nuneaton CV11 5AA.

Subtitled, an approach to risk management, the conclusions from this 2 year study of landfill gas problems in Warwickshire and Coventry could be applied to any closed landfill site in the UK. The report also describes the legislative framework, standard investigative procedures, guidelines for risk analysis and control and emergency procedures.

SUSTAINABLE SETTLEMENTS
A Guide for Planners, Designers and Developers

University of the West of England/Local Government Management Board, 1995. ISBN 0 7488 9796. No price quoted.

This Guide aims to help planners, designers and developers to collaborate in conversion of the rhetoric of sustainable development into the practical action of Agenda 21.

THE GREEN HOME

K. Christianson. Piatkus, 1995. £9.99. ISBN 074991 460.

Unlike many books of this genre, this is a sensible, useful and enjoyable guide to achieving a more sustainable way of life. In contrast to the various "green" consumer guides which have been published, it is not a directory of products and it avoids the extremes of some holistic guides. The book provides practical ways of consuming less and living a "green" lifestyle.

URBAN AIR POLLUTION
Volume 1

Ed H. Power et al. Computational Mechanics Publications, 1994. £95.00. ISBN 1562522558.

A selection of invited review articles covering urban air pollution. Part 1 consists of six case studies covering problems in different urban areas around the world; Part 2 examines urban air pollution processes.

EC TREATY AND ENVIRONMENTAL LAW
Second Edition

Dr. L. Krämer. Sweet & Maxwell, 1994. £25.00. ISBN 0421508906.

This detailed analysis of the law and policy of the European Community gives an insight into the principles and processes of EC environmental legislation. It examines the regulation of each type of pollution. It also looks at the relationship between the Treaty of Rome and environmental legislation, as well as the relationship between Community and National law.

HOUSEHOLD WASTE RECYCLING

R. Waite. Earthscan, 1995. £29.95. ISBN 1853832421.

A comprehensive overview of the options available for the disposal of household waste and the potential for developing recycling. Chapters cover collection options, separation of waste, the reprocessing of recyclable materials, packaging and future options. The book provides all the information necessary for anyone assessing potential costs and viability of setting up recycling schemes.

THE NOISY NEIGHBOUR SURVIVAL GUIDE

P. Michel. Spot on Publishing, 1995. £5.00. ISBN 0952566109.

A detailed guide to the problem of neighbour noise. There are useful pointers such as consideration of house and flat layout, potential sources of noise, and practical methods of improving sound insulation. However, the first chapter "Sorting Your Neighbour Out" seems rather confrontational and negative in tone, implying that neighbours are in themselves a problem to be dealt with.

AIR QUALITY IN LONDON 1994

The second report of the London Air Quality Network

South East Institute of Public Health, 1995. £25.00. ISBN 1874257.

The report collates data from the network which covers 30 sites in London, monitoring carbon monoxide, ozone, nitrogen dioxide, benzene and particulates. Compared to 1993 data it shows the number of exceedances of air quality guidelines and the annual averages have increased over the last year. Health effects, siting and operation of the network, air quality management and results of monitoring are also covered.

MARINE EXHAUSTS RESEARCH EMISSIONS PROGRAMME

Lloyds Register, 1995.

The third report in a research series initiated by the International Maritime Organisation to determine the significance of exhaust emissions from shipping. Focusing on particulate emissions from diesel engines, emissions from fuel oil engines were higher than those from gas oil engines. Highest emission rates were found in the Dover Straits, English Channel, with NOx and sulphur dioxide emissions for the whole of the study area similar to those of France, Spain and the UK.

EFFICIENCY GAINS

Business Success through Resource Efficiency

CBI, 1995. £5 to members; £10 non-members. ISBN 0852014945.

This booklet aims to help businesses of all sizes develop waste minimisation, energy and transport efficiency, which will both minimise environmental impact and improve performance. Case studies include Kodak who have recycled 38 million single use cameras as "design for recycling" – not exactly a good example of waste minimisation and surely it would be more energy efficient to make cameras which could be used more than once. The booklet also covers management, design, operational efficiency and political and legislative developments.

SETTING THE STANDARD

Environmental Management Systems

CBI, 1995. £5 to members; £10 non-members. ISBN 0852014899.

This booklet outlines the principles behind effective management systems, the factors influencing environmental performance and ways in which environmental management can be incorporated into business activities. It also examines the certifiable systems available and sources of further advice.

FUTURE EVENTS

11-12 September - EUROPEAN ENVIRONMENT CONFERENCE

Of interest to policy makers, NGOs, consultants, researchers and academics, local authorities and practitioners, the focus is on practical papers aimed at improving environmental performance in a European context.
Venue: University of Nottingham.
Details: Conference Manager, ERP Environment, Fax: 01274 530409.

11-15 September - 23RD EUROPEAN TRANSPORT FORUM

Each September delegates from all parts of the world congregate at the ETF to hear the latest research and development and examples of good practice and to discuss policy issues relating to highways, transport and planning.
Venue: University of Warwick.
Details: Sally Scarlett, PTRC.

13-14 September; 31 October/1 November - PRINCIPLES OF ENVIRONMENTAL MANAGEMENT

Course for companies wishing to develop in-house expertise in environmental management. Describes national and international environmental management system standards; overview of BS 7750, EMA Regulation, legal aspects etc.
Venue: London.
Details: Lynn Morgan. Det Norske Veritas Industry Ltd. Tel: 0171 357 6080, Ext 676.

15 September; 2 November - STANDARDS OF ENVIRONMENTAL MANAGEMENT

This course focuses around BS7750, explaining its implications for industry and environmental auditors.
Venue: London.
Details: Lynn Morgan, as above.

18-19 September - INCINERATION OF MUNICIPAL WASTE WITH ENERGY RECOVERY

Two day course providing introduction for all those considering the incineration option for the disposal of municipal solid waste. Detailed coverage of the incineration process and asociated problems.
Venue: University of Leeds
Details: Julie Charlton, Dept of Fuel & Energy, University of Leeds, Fax: 0113 233 2511.

20-21 September - BUSINESS STRATEGY AND THE ENVIRONMENT CONFERENCE

What industry is doing to improve its environmental performance and analysis of tools to develop that further. Discussion of how businesses can contribute to the move towards sustainable development.
Venue: University of Leeds.
Details: Conference Manager, ERP Environment, Fax: 01274 530409.

28, 29 September, 16, 17 October - PLANNING FOR BS 7750 CERTIFICATION & EMAS VERIFICATION

Four one-day comprehensive tutorials for managers in industry and business with responsibility for environmental management.
Venues: Hotel Piccadilly, Manchester (28/9); Marriott Hotel, Newcastle upon Tyne (29/9); Forte Crest, Exeter (16/10); Forte Crest, Regents Park, London (17/10).
Details: Amanda Jones, IBC Technical Services, Tel: 0171-637 4383.

2-3 October - LOCAL SUSTAINABLE DEVELOPMENT

Two day conference aimed at those implementing Local Agenda 21; strategic plans and awareness-raising initiatives need to effectively place sustainability at the heart of corporate goals and community concerns.
Venue: The Gloucester Hotel, London SW7.
Details: IIR Ltd. Fax: 0171 915 5056.

4 October - NOISE AND HEALTH

Organised by the Faculty of Public Health Medicine and the Faculty of Occupational Medicine in collaboration with the Institute of Acoustics to raise awareness of the effects of noise on health in the environment and the workplace, the scientific work that has been conducted and the ways in which noise is measured in the environment and the workplace.
Venue: Cavendish Conference Centre, London.
Details: Karen Stone/Rosemary McMahon, Professional Briefings, Fax: 0171 233 7779.

23-26 October - ENVIRONMENTAL PROTECTION 95

62nd NSCA conference and exhibition - see separate advertisement for details, or telephone 01273 326313 for a copy of the programme.

3-5 December - COMBUSTION AND EMISSIONS CONTROL

NSCA is one of the co-sponsors of the 2nd international conference which aims to provide a forum for discussing state of the art technology and experience, as well as exploring innovative research leading to further developments.
Venue: Commonwealth Conference Centre, London.
Details: Mrs J. Mackenzie, Institute of Energy, Fax: 0171 580 4420.

nsca

CLEAN AIR

AND ENVIRONMENTAL PROTECTION

AUTUMN 1995

Volume 25 Number Three

NATIONAL SOCIETY FOR CLEAN AIR AND ENVIRONMENTAL PROTECTION

AUTUMN 1995
VOLUME 25
ISSN 0300-5734

CLEAN AIR

Publishing Director:
Dr. Tom Crossett
Secretary General, NSCA

Editor:
Loveday Murley

Communications Officer:
Tim Brown

Advertising:
Sally May
Rates on request.

CLEAN AIR is the official journal of the Society but the views expressed in contributed articles are not necessarily endorsed by the Society.

CLEAN AIR is issued free to Members and Representatives of Members.

CLEAN AIR Subscription for
1995 – £24.00
1996 – £25.00

CLEAN AIR is printed and published in England by the National Society for Clean Air and Environmental Protection, 136 North Street
Brighton BN1 1RG
Tel: 01273 326313
Fax: 01273 735802
Email: cleanair@mistral. Co. UK

CONTENTS

EDITORIAL

TARGETING ACTION ON AIR POLLUTION AND HEALTH

Under the *Environment Act 1995* local authorities must assess air quality and develop action plans if necessary, to meet the air quality standards which will shortly be announced by DOE. Those standards, and the target dates for attainment, will dictate the pace of change for improving air quality. The Government is advised by the independent Expert Panel on Air Quality Standards. EPAQS recommendations for three air pollutants - carbon monoxide, benzene and 1.3 butadiene - have been all but accepted by Ministers and emissions projections published in the last edition of *Clean Air* suggest that attainment is within our grasp. The fourth recommendation - a standard for ozone - is more controversial. It is unlikely to be attained by 2005, in fact levels will probably worsen in the medium term, but the Government argues with some justification that ozone is a European transboundary problem and not amenable to local control. The most recent EPAQS report on sulphur dioxide also sets a challenging standard.

But it is the next two EPAQS recommendations which we believe will pose more challenging questions, linking air pollution, health and transport issues, and where rational standards could lead to real changes at local level. World Health Organisation guidelines for nitrogen dioxide are widely exceeded in the UK, and Ministers would find it hard to justify setting a more relaxed standard. New evidence on the health impact of the tiny airborne particles known as PM_{10} suggests that it may be impossible to identify a "safe" level below which effects are insignificant. Ministers may have to decide what level of morbidity and mortality is an acceptable price to pay for society's increasing mobility, or what price we must pay (in terms of new technologies and enforcement) to sustain that mobility.

Health authorities and environmental health departments are now beginning to cooperate in relating air quality monitoring to local health effects. For example, recent work has tried to match rates of asthma inhaler use, or hospital admissions, with pollution episodes. But ambient monitoring - usually outdoors - is a poor guide to individual exposure. Levels of carbon monoxide, nitrogen dioxide or benzene may be higher inside some homes than in the street outside. Pollutants with long-term chronic, or short-term acute, effects will demand a different assessment regime. If we are to protect the public we shall need to refine our methods of assessing health benefit, and may need to revise standards in the light of emerging new understanding.

It is particularly timely that NSCA will host a seminar on health and air quality management in December. The framework for integrating local action on health and air quality has been developing loosely around Local Agenda 21 and Healthy City initiatives, and could be consolidated through the UK Environment and Health Action Plan

(UKEHAP) jointly published by DOE and the Department of Health in August. The national air quality strategy, expected before the end of the year, will be the key policy instrument. The new *Environment Act* offers the prospect of directing pollution control where the benefits to health will be greatest, but it must be done on the basis of sound science and coordinated action, which takes account of the total risk assessment of air pollutants. Environmental health and public health specialists will need to work together to ensure that air quality management plans really do target those most at risk from pollution in the most cost-effective and socially acceptable manner. Our seminar is designed to advance thinking on this central issue.

NSCA NEWS

DIRTY DIESEL DETECTION DAYS

Last Autumn, NSCA invited local authorities to participate in our campaign to combat the nuisance caused by unacceptably smoky buses and HGVs. Local authorities were asked to organise dirty diesel detection days in town centres to spot and report smoking vehicles to the Department of Transport. The main objective was to encourage enforcement agencies to take action against smoky vehicles, to evaluate the potential local authority role in enforcement and to raise awareness of diesel pollution. Plans for the initiative were drawn up with assistance from the DoT and the Department of Environment and an action pack and report forms produced.

Dirty diesel detection days were held between November 1994 and June 1995 and NSCA has now produced a report based on returns from the 80 participating local authorities (note: 63 LAs provided statistical information and 17 comments).

The main findings and recommendations are:

- the majority of LA officers were keen to get involved in enforcement;
- 40,570 vehicles were spotted - about 8.5% of the UK fleet. Of these 2.2% were reported to the enforcement authorities;
- operators, once reported, were keen to cooperate and comply with the law;
- lack of feedback from the Vehicle Inspectorate undermined enthusiasm for reporting vehicles;
- if LA officers are to become involved in vehicle emission enforcement, training, manpower and financial resources will be required, along with cooperation from the Vehicle Inspectorate, the police and DVLC; a freephone number and uniform procedure for the public to report smoky vehicles should also be available.
- frustration was expressed at the apparent laxity of current emission standards - vehicles deemed unacceptably smoky by the public and some LA officers were found to pass current emission tests; there is a need for current emission standards to be reviewed in the light of new evidence on health and environmental impacts.

A copy of the full report with statistical data, *Local Authority Dirty Diesel Detection Days*, has been sent to participating local authorities. Copies of the report are available from NSCA, price £10 inc p & p.

DIVISIONAL NEWS

East Midlands and Eastern Divisions

Since the last issue of *Clean Air* there has been one Divisional meeting - on 27 September - when 38 members and guests visited Sizewell "B" Nuclear Power Station on the Suffolk coast.

It is however extremely disappointing to report the lack of interest in open meetings from Eastern Division members - despite arranging two meetings within the Eastern Division's boundary, there has been virtually no interest from existing members in the Division; this probably also accounts for the fact that no new members have been recruited from the Eastern Division's area. Only by members becoming actively involved in the activities of the Divisions can NSCA be sure that it is representing the views of all its members in **all** areas and indeed can it be sure that it is providing the sort of service that **all** its members want.

The Sizewell "B" visit was extremely interesting with presentations from the Communications Officer, Beverly Davies, who described how the station had been built with safety in mind. The well-proven design of Pressurised Water Reactor (PWR) had been modified to build in additional safety elements and controls. The plant was now fully commissioned and feeding power into the National Grid at its design level.

A second presentation by Mike Oldfield, Sizewell's Environmental Officer, was targetted at on-site environmental performance and generated considerable interest in questions afterwards. He explained that it was difficult to win people over to nuclear power generation because public opinion was largely against the industry. He presented some interesting comparisons with pollution emissions from coal-fired generation emphasising that in the case of the nuclear industry, the emissions were "managed". He went on to explain the measures being taken to enable the site to apply for certification as complying with BS 7750 (Environmental Management System); these included environmental legislation registers and the setting up of a significant environmental effects register for **all** activities carried out at the site. A buffet lunch was followed by tours of the site with all attendees being supplied with a corporate information pack. The Chairman of the Division thanked Nuclear Electric for hosting what had been a most enjoyable, interesting and informative visit.

Statistics for the Dirty Diesel Detection Day for the Region have now been compiled. The Results for 14 Councils from the two Divisions are similar to the national figures, i.e.

	Observed	*Reported*
Heavy goods vehicles	9,028	133 (1.5%)
Buses/coaches	1,317	49 (3.7%)
Public service vehicles	503	3 (0.6%)
Taxis/private hire vehicles	770	1 (0.1%)

While there appears to be little interest among member authorities in carrying out any further "spotting" days, other initiatives to monitor vehicle pollution are being considered.

South East Division

With the demise of British Coal, the South East Division is saying goodbye to Hobart House (the headquarters of the British Coal Corporation in London) where Divisional meetings and AGMs have been held regularly for the past 12 years. The Division's final meeting there will be on 8 November at 11.00 a.m. On behalf of the Division we would like to express our thanks to British Coal for their cooperation and helpfulness in providing such a central and popular venue. We should also like to thank Mrs Pat Naylor (Chairman of the Division 1983-90 and Chairman of the Women's Smokeless Fuels Council 1971-91) whose good services made the venue possible.

Fortunately an alternative venue has been found at Hampton House, 20 Albert Embankment, London W1, courtesy of the London Waste Regulation Authority.

As mentioned in the summer edition of *Clean Air*, the Division is to hold a conference, in conjunction with the South East Institute of Public Health on "Asthma: confronting the myth". This will be held on 14 November from 9.30 - 4.30 at Governor's Hall, St. Thomas Hospital, London SE1. The cost of attending for NSCA/LAQN members is £50; non-members £65; and students £15 (stand by basis).

The aim of the conference is to provide factual information about asthma, its causes, prevalence and treatment, allergic responses, and to apply a public health perspective for responding to asthma. This controversial topic should be of interest to all members and those concerned with environmental and public health issues.

West Midlands Division

The West Midlands Division held its annual general meeting on 11 October at Stratford-on-Avon when NSCA Secretary General, Tom Crossett presented Len Medlycott with a Certificate of Honorary Membership in recognition of Len's nine years as Hon. Secretary of the Division. In a presentation to the Division, Dr. Crossett described the Society's successful lobbying activities, in particular with regard to the air quality management provisions of the (now) *Environment Act 1995*. In the afternoon the Division visited Sims Bird Ltd.

The Division's next meeting will be on 11 January 1996 at Cannock when Roger Key, Regional Director of Business in the Environment will talk about the activities of that organisation.

REPORTS

CORRECTING DISCHARGE STACK HEIGHTS TO ACCOUNT FOR LOW GAS DISCHARGE VELOCITIES

D.J. Hall
Building Research Establishment

SUMMARY

The report considers the problems of plume downwash in the lee of discharge stacks when discharge velocities are low. The main difficulty that this causes is a lowering of the effective stack height. The minimum efflux velocities set in the various guidance notes and memoranda (in particular, in HMIP Guidance Note D1 (HMIP; 1993) are intended to avoid this problem. However in some types of discharge, combustion plant using natural draught for example, the discharge velocities can be low enough for downwash to occur. In these cases, if it is not practicable to increase the discharge velocity to an acceptable value, it is desirable that the discharge stack height should be increased to compensate for the reduced plume height. The present report discusses the critical aspects of plume downwash in relation to correcting stack height calculations and provides some simple formulae for doing so.

1 Introduction

The original cause of this note was a concern over the stack discharge velocities for glass furnaces. Since these often run on natural draught the discharge velocities are relatively low. They are thus unable to meet the requirement of $15ms^{-1}$ laid down in the relevant process guidance notes (PG3/3(91) and PG3/4(91)). Similarly, the HMIP Guidelines on Discharge Stack Heights (HMIP; 1993) recommend a minimum efflux velocity of $15ms^{-1}$ for discharges with a heat release exceeding 1MW. In a submission to the Department of Environment (DOE), one user of glass furnaces has proposed that a discharge velocity of $8ms^{-1}$, similar to the requirements of recent regulations in France, should be acceptable. A glass furnace running on natural draught should be able to achieve this discharge velocity. Two arguments were put forward in support of this proposal. Firstly, that heat release from a typical glass furnace is around 3MW and the plume rise of the discharge is dominated by this heat release, the stack discharge velocity having very little effect on the calculated plume height. Secondly, that a paper discussing stack discharge conditions (Scorer; 1959) has commented that excessive discharge velocities may have a deleterious effect on the plume rise of buoyant discharges.

This argument is perfectly correct, as far as it goes. However it fails to appreciate the main purpose of a minimum discharge velocity, which is to ensure that the discharge

clears the stack without being entrained into its wake. If this occurs, the plume is entrained down the outside of the stack, on the downwind side, and this both reduces the plume rise and the effective height of the stack. A diagram of this effect, taken from the ASHRAE handbook (ASHRAE; 1993), is shown as Figure 1, though the subsequent discussion will show that this is not a perfectly accurate description of the plume behaviour. Even if this initial downwash does not apparently affect a long range plume rise calculation, it can cause difficulties at shorter distances by encouraging building downwash effects. The majority of stack heights have to be increased to avoid plume downwash due to the effects of building aerodynamics and these problems will be exacerbated by any additional reduction in effective plume height due to low discharge velocities.

Scorer's comment on the deleterious effect of excessive discharge velocities on plume rise was concerned with the effects of a high discharge velocity generating a rapid initial dilution of the plume near the discharge point. This increases the mass of air on which the buoyancy force acts, so that buoyant plume rise is thereby reduced. Though this effect is correctly stated by Scorer, it diminishes with increasing distance from the stack. Also, to be significant it usually requires much higher discharge velocities than the minimum velocities associated with avoiding plume downwash around the stack, which are close to an optimum discharge velocity for ensuring the maximum buoyant plume rise. If discharge velocities are reduced below these values, so as to result in plume downwash around the stack, then there is a greater initial dilution of the plume and a consequent reduction in buoyant plume rise for this reason.

The majority of combustion and process plant use draught fans, so that there is no difficulty in principle in meeting the required minimum discharge velocities. However there are some processes and combustion plant that still prefer to use natural draught. Typical examples are the glass furnaces discussed above and gas fired heating plant up to a few MW capacity. For smaller plant using natural draught, stack discharge velocities can be very low, only a few ms^{-1}. The use of draught fans should be a preferred option. Not only can they produce the desired minimum discharge velocities, but also draught fans provide a strong buffering against the effects of wind downdraughts when these occur. Wind downdraughts can have serious effects on low velocity natural draught discharges, but these problems only usually occur when there are nearby buildings or topography higher than the discharge stack.

However, while plant driven on natural draught is considered acceptable, there ought to be some procedure for adjusting stack heights to account for the plume downwash around the stack that results from low discharge velocities. At present, no UK Process Guidance Note or stack height calculation method specifically accounts for this effect. Both the 3rd Edition of the Memorandum on Chimney Heights (DOE; 1981) and the new Guidance Note D1, Guidelines on Discharge Stack Heights for Polluting Emissions (HMIP; 1993), simply state the minimum discharge velocities required to avoid plume downwash problems. The Memorandum also notes that small boilers on natural draught may not be able to achieve the required minimum discharge velocity of $6ms^{-1}$, but does not offer further advice.

The present report explains the background behind the current advice on minimum discharge velocities, considers the technical information presently available on plume

downwash behind discharge stacks and provides some simple procedures for correcting stack heights for downwash, using Guidance Note D1.

2 Minimum Discharge Velocities

There is a limited discussion of minimum stack discharge velocities in the background report to Guidance Note D1 (Hall and Kukadia; 1993). Some of this is repeated here, but the discussion is extended.

For many years a rule of thumb for avoiding plume downwash was that the discharge velocity should exceed the windspeed at the top of the stack by some amount. The commonly suggested factor was 1.5, which has been used in the HMIP's internally published guidance. There was some very early experimental work on the subject by Sherlock and Stalker (1941), which was the subject of a discussion by Halıtsky (1978). Snyder (1974) investigated the matter in greater detail using small scale stack models in a wind tunnel, where the experimental conditions could be very controlled. The main result of his work is shown in the plot in Figure 2. This shows the boundary between plumes clearing the stack or suffering downwash as a function of the ratio of stack discharge velocity on the left hand scale and of the Froude number of the discharge along the axis. The Froude number is the other controlling parameter of a buoyant discharge, its value for most practical discharges falls on the right hand half of the figure. It can be seen that the velocity ratio is also scaled by the square root of the density ratio of the discharge to the ambient value. This makes the ratio one of the momenta of the discharge to the ambient windflow, which is the correct governing ratio rather than the velocity ratio alone. Thus to avoid downwash of a high temperature discharge, the velocity ratio ought to be increased to account for the reduced gas density. The "Rule of Thumb" velocity ratio of 1.5 is also marked on the figure as a broken line and it can be seen that it lies close to the dividing line of the experimental data on the right hand half of the figure, where most practical discharges lie.

It will be appreciated from the above that, before setting an adequate stack discharge velocity to avoid downwash, some value of the windspeed must be assumed. Also, that for windspeeds beyond this assumed value some plume downwash becomes inevitable. Thus to avoid downwash altogether a high windspeed, at some plausible upper bound, must be assumed for setting the stack discharge velocity. Guidance Note D1 used an upper bound windspeed of 20ms^{-1} for its dispersion calculations, approximately the 98%ile upper bound of UK windspeeds. However if this value had been used the required discharge velocity would have been 30ms^{-1}, which is impractically high for most plant and causes secondary problems such as excessive noise.

An alternative approach is to use as a basis the windspeed at which maximum ground level concentrations occur. It is a feature of the dispersion of a discharge with a fixed heat release and/or discharge momentum that the highest concentration at the ground within a plume first increases with increasing windspeed, passes through a maximum at a critical windspeed and then decreases with further increases in windspeed. If the basis for setting the stack discharge velocity is taken as this critical windspeed, then further increases in windspeed will result in some plume downwash and the reduced plume height will result

in an increase of ground level concentrations. However, the reduction in maximum ground level concentration that additionally accompanies the increases in windspeed beyond the critical value will, to some extent at least, compensate for increases due to plume downwash.

In its internally circulated guidance, HMIP used this approach, recommending a critical windspeed of about $6ms^{-1}$ for low stacks, increasing to $10ms^{-1}$ for taller stacks. This gives rise to minimum discharge velocities of about $10ms^{-1}$ and $15ms^{-1}$ respectively. In preparing Guidance Note D1 the matter was examined in more detail. Figure 3, taken from the background report, is an example of the calculations carried out for the document. It shows, for a fixed heat release of 10MW in the discharge, the maximum plume concentrations at the ground for a range of windspeeds and discharge stack heights. It can be seen in the figure that for the highest stack, of 200m, the critical windspeed is around $6ms^{-1}$. As the stack height is reduced the critical windspeed increases, so that for stacks below 10m height the critical windspeed is beyond the upper windspeed of the calculations, of $20ms^{-1}$. The critical windspeed also varies with the heat release or the momentum in the discharge, increasing as their values increase.

Thus in principle the critical windspeed for setting the discharge velocity ought to be a function of both the buoyancy and momentum in the discharge and of the stack height. In preparing the Guidance Note D1, a full procedure for estimating discharge velocities in this way was considered, but rejected as too complex. Instead discharge velocities were set as a function of heat release or discharge momentum only, the values being upper bounds of the effects of stack height. The values originally proposed on this basis were:

Based on heat release:

Below 0.1MW	$10ms^{-1}$
1MW	$15ms^{-1}$
Above 10MW	$20ms^{-1}$

Based on discharge momentum (as defined in the guidance):

Below 10	$10ms^{-1}$
Above 100	$20ms^{-1}$

Between these levels linear interpolation gave acceptable velocities and for a given discharge the required velocity was whichever of the two, for momentum or buoyancy, was the greatest.

There are practical upper limits to discharge velocities beyond about $20ms^{-1}$, due to excessive draught power requirements, noise and to problems of detaching and discharging particles and liquid droplets from the stack walls.

In considering an early draft of the guidance it was noted that the higher velocities were at odds with the largest recommended velocities in the various Process Guidance Notes and other advisory documents which were starting to appear at that time. In order to maintain some consistency, the highest velocities in the guidance were reduced to $15ms^{-1}$. These would be adequate in many cases, especially for the smaller plant and lower stack heights for which the guidance is mainly intended. However, for large plant higher discharge velocities would be preferable.

3 Plume Downwash Behind Discharge Stacks

For discharge velocities below the critical values, some allowance has to be made for the effective loss of plume rise and, therefore, of stack height that plume downwash causes. A correction which has been in use for many years is due to Briggs (1973). It had the form,

$$h' = h_s + H_d, \qquad (1)$$

where,

$$H_d = 2\,(w/U - 1.5)\,D. \qquad (2)$$

H_d is the effective reduction in stack height,
h_s is the original stack height,
h' is the final modified stack height,
w is the stack discharge velocity,
U is the windspeed at the top of the stack, and
D is the stack diameter.

Equation 2 alone was reproduced by Hanna, Briggs and Hosker (1982) and again in the ASHRAE handbook, in concert with Figure 1 (where the notation is as above). There seem to be some differences in the way this formula is applied. Hanna, Briggs and Hosker state that "the distance (h_d) that the plume downwashes below the top of the stack can be found from the following formula", indicating that the formula applies for estimating plume downwash below the top of the stack for values of w/U below 1.5 and that in these circumstances there is no initial plume rise. In the ASHRAE handbook, Figure 1 implies that the formula corrects for reduction in the plume height due to downwash, but that this is not necessarily below the top of the stack as the plume height includes the local plume rise close to the stack. Briggs was not explicit on this point originally. If his formula is used to correct a conventional plume rise calculation, it accounts for initial plume rise in the same way as in the ASHRAE handbook and the plume does not necessarily fall below the top of the stack. In principle, the use of equation 2 as an additional correction for reduction in plume height would seem more rational. The onset of stack-induced downwash is not sudden but develops steadily as w/U reduces below 1.5, so that the plume height does not immediately fall below the top of the stack. However, Hanna, Briggs and Hosker's application of the formula is conservative, so represents a reasonable regulatory approach to a matter which has not been well quantified.

More recently, Snyder and Lawson (1991) have investigated the downwash of plumes behind stacks in great detail, again using small scale models in a wind tunnel. The behaviour of plumes entraining behind stacks proved quite complex. They identified two different behavioural regimes, subcritical and supercritical, for low and high stack Reynolds numbers respectively. The division between the regimes corresponded to a stack Reynolds number around 60,000, which in practical terms corresponds approximately to

$$wD \simeq 1\ m^2s^{-1}, \qquad (3)$$

where w and D are in ms^{-1} and m respectively.

In practice nearly all discharge stacks fall into the higher, supercritical regime.

Snyder and Lawson measured the position of plume centroids over a wide range of conditions of downwash. Their measured plume heights are shown in Figure 4 (reproduced from Figure 19 of their paper). The plot is of the height of the centroid of the plume, measured 30 stack diameters downwind, as a function of the stack discharge velocity ratio, w/U. The plume height is given as a ratio relative to the stack diameter, z/D. The top of the stack corresponds to z/D = 0. The figure shows two sets of data, for the subcritical and supercritical cases respectively. The upper set, for the supercritical case, is that of practical interest here.

The measurements of plume height in Figure 4 for the supercritical case show a rapidly reducing plume height as the discharge velocity ratio, w/U, falls. The centroid of the plume falls to about the same height as the stack when w/U is reduced to 0.3. It is of interest that in the supercritical case the plume centroid does not really fall below the top of the stack unless the discharge velocity ratio is very small. However at this condition, Snyder and Lawson's measurements show that the plume achieves a considerable vertical spread close to the stack so that the lower half of the plume, which will be below the top of the stack, has entrained down the stack by about four stack diameters. Thus any practical example of this condition would appear to show severe plume downwash below the top of the stack.

Also shown on Figure 4 is a solid line of Snyder and Lawson's interpretation of Briggs' downwash equation (equation 1), together with their own fits to the data. They have followed Hanna, Briggs and Hosker, assuming that there is an immediate onset of plume downwash as w/U falls below 1.5. Briggs' equation is therefore drawn through zero plume height (that is, height above the top of the stack) for the normal lower limit of discharge velocity, w/U = 1.5. On this basis, Briggs' equation falls well below the experimental measurements and it is therefore remarked by Snyder and Lawson that it significantly overestimates the downwash correction. If the alternative interpretation is assumed, that Briggs' equation estimates not the absolute plume height but the amount of additional downwash due to stack entrainment, the line for Briggs' equation should be drawn through the data at w/U = 1.5 and it is the slope of the line that should be compared with the slope of the data. On this basis Briggs' equation is actually a reasonably good fit to both the subcritical and supercritical stack data. Briggs' equation has been transposed to the supercritical stack data, the broken line in Figure 4, and it can be seen that, though its slope is a little steeper than the data, it fits well enough for practical purposes down to w/U = 0.6. Below this there are only a few measurements, but it looks as if below w/U = 0.6 the slope of the data increases by about a factor of three over Briggs' equation.

An alternative approach to estimating the downwash is simply to use a conventional plume rise equation to compare the data with estimates of reduced plume rise due to the reduced momentum in the discharge. In the dimensionless form in which Figure 4 is plotted, Briggs' equation for plume rise due to discharge momentum only has the form,

$$z/D = 1.45\,(w/u)^{2/3}\,(x/D)^{1/3}. \qquad (4)$$

At x/D = 30, the distance from the stack at which the measurements of Figure 4 were made, a calculation of plume height for w/U = 1.5 using equation 4 produces a plume height about twice that of the supercritical stack data in Figure 4. It is not surprising that there should be a difference of this order. Briggs' equation will not apply perfectly very

close to a stack, also Snyder and Lawson's measurements are not in a perfectly simulated atmosphere and were intended to measure differences in plume height due to stack downwash rather than absolute values. Equation 4 can also be used to estimate the differences in plume rise that would result from reduction of momentum in the plume discharge in a conventional calculation. The results of this are shown in Figure 4 as a fine broken line. The reference point is the plume height at w/U = 1.5 as before. It can be seen that this method also estimates the reduction in plume height quite well down to about w/U = 0.6, as with Briggs' downwash equation.

It seems therefore, that the plume downwash for w/U below 1.5 can be predicted reasonably well down to w/U = 0.6 either using Briggs' downwash equation in the form indicated in the ASHRAE handbook (equation 2) or by estimating the reduced plume rise due to the reduced discharge momentum with Briggs' conventional plume rise equation for plume rise due to discharge momentum. For w/U below 0.6 a much greater correction seems to be required, at about three times the rate of Briggs' downwash equation, (equation 2). Snyder and Lawson provided equations for empirical curve fits to their subcritical data (which appear in Figure 4) in two parts, for which the correction for low values of w/U, below about 0.6, is of this order. These equations could also be used to the supercritical stack data for the reduction in plume height for w/U below 1.5, for which they would be an equally good fit.

4 Application of Stack Downwash Corrections to Guidance Note D1

The main concern in applying a stack downwash correction to calculations using HMIP Guidance Note D1 is that the uncorrected stack height for discharge momentum only, U_m, should be adequately increased to account for the reduced plume rise due to stack downwash. Where there is a significant heat release this may not affect the uncorrected stack height (the lesser of U_b and U_m), but it will still affect the building height correction, to which U_m contributes. This is highly desirable since building downwash will be exacerbated by any additional reduction in plume height due to additional stack downwash.

Though either of the two procedures outlined immediately above would be practicably acceptable, that of estimating the reduced plume rise using Briggs' plume rise equation is already effectively built into the Guidance Note. U_m is calculated using the stack discharge momentum, so that reduced plume rise due to a low discharge velocity (and consequently low discharge momentum) would be automatically compensated by an increase in U_m. Some checks on the increased stack heights resulting from reduced discharge momentum always produced increases in stack height significantly greater than the reductions in plume height indicated in Figure 4. This would therefore seem to be an adequate procedure down to w/U = 0.6. Below this the rapid onset of more severe downwash makes a greater correction desirable. In this region the application of Briggs' downwash equation, equation 2, with about three times the order of correction would seem most suitable. This would be of the form,

$$\Delta h = 9\,(0.4 - w/w_0)\,D, \qquad (5)$$

where w/w_0 is the ratio of the actual discharge velocity, w, to the recommended value, w_0.

The largest increase in stack height from equation 4 is 3.6D for $w/w_0 = 0$. This is close to the largest downwash of any part of the plume, of about 4D, observed by Snyder and Lawson.

Since for w/U below 0.6 the discharge momentum would be so low as to produce very little plume rise, it would be appropriate to calculate U_m assuming that the discharge momentum was at the lowest value in Figure 4 in the Guidance Note (that is $2m^4s^{-2}$) before the additional correction of equation 5 was made.

A qualification to Guidance Note D1 for low efflux velocities could thus read:

It is good practice for the minimum discharge velocities in section 6.1.1 to be adhered to wherever possible. However, there may be some reason due to existing practice or practicability when only lower velocities are achievable. Where this is the case, the value of U_m should be increased to account for the reduced plume rise.

For values of discharge velocity down to 40% of the recommended discharge velocity, U_m can be calculated in the conventional way, using the actual discharge velocity rather than the recommended value.

Values of the discharge velocity below 40% of the recommended value should only be accepted in exceptional circumstances. Where this is unavoidable:

1. Calculate a value of U_m assuming the lowest value of discharge momentum in Figure 4 of the guidance, that is $2m^4s^{-2}$.
2. Add to the calculated value of U_m, the additional height given by,

   $\Delta h = 9\ (0.4 - w/w_0)\ D$,

where Δh is the increment in stack height,
D is the stack diameter (or of the shroud of a shrouded multi-flue stack) and
w/w_0 is the ratio of the actual, w, to the recommended, w_0, discharge velocity.

5 Acknowledgements

This report has been produced for the Local Authority Unit of the UK Department of the Environment's Air Quality Division (BRE Client Report CR 103/95).

6 References

ASHRAE (1993). Airflow Around Buildings. American Society of Heating, Refrigeration and Air Conditioning Engineers. ASHRAE Handbook 1993. Fundamentals. Chapter 14.

Briggs (1973). Diffusion Estimates for Small Emissions. NOAA, Oak Ridge Atmospheric Turbulence and Diffusion Laboratory, USA. ADTL No 79.

DOE (1981). Chimney heights. 3rd Edition of the 1956 Clean Air Act Memorandum. HMSO. ISBN 0 11 751556 6.

Halitsky J. (1978). Comment on a Stack Downwash Prediction Formula. Atmospheric Environment, Vol. 12 pp1575-1576.

Hall D.J., Kukadia V. (1993). Background to the New HMIP Guidelines on Discharge Stack Heights for Polluting Emissions. Warren Spring Laboratory, Report No LR 929.

Hanna S.R., Briggs G.A., Hosker R.P. Jr (1981). Handbook on Atmospheric Diffusion. Chapter 3, p19. US Office of Health and Environmental Research, US Dept of Energy. DOE/TIC-11223.

HMIP (1993). Guidelines on Discharge Stack Heights for Polluting Emissions. Technical Guidance Note (Dispersion) D1. HMIP, June 1993. HMSO, ISBN 0 11 752794 7.

Scorer R.S. (1959). The Behaviour of Chimney Plumes. Int. J. Air Pollution, Vol 1, pp198-220.

Sherlock R.H., Stalker F.A. (1941). A Study of Flow Phenomena in the Wake of Smokestacks. Dept of Engineering Research, Univ. of Michigan, Ann Arbor. Eng Res Bull No 29.

Snyder W.H. (1974). Fluid Modelling Programme of the Meteorological Laboratory, USEPA. Proceedings of the Fifth NATO CCMS Meeting of the Expert Panel on Air Pollution Modelling, 4-6 June, RISO, Denmark.

Snyder W.H., Lawson R.E. Jr (1991). Fluid Modelling Simulation of Stack-Tip Downwash for Neutrally Buoyant Plumes. Atmospheric Environment, Vol 25A, No. 12, pp2837-2850.

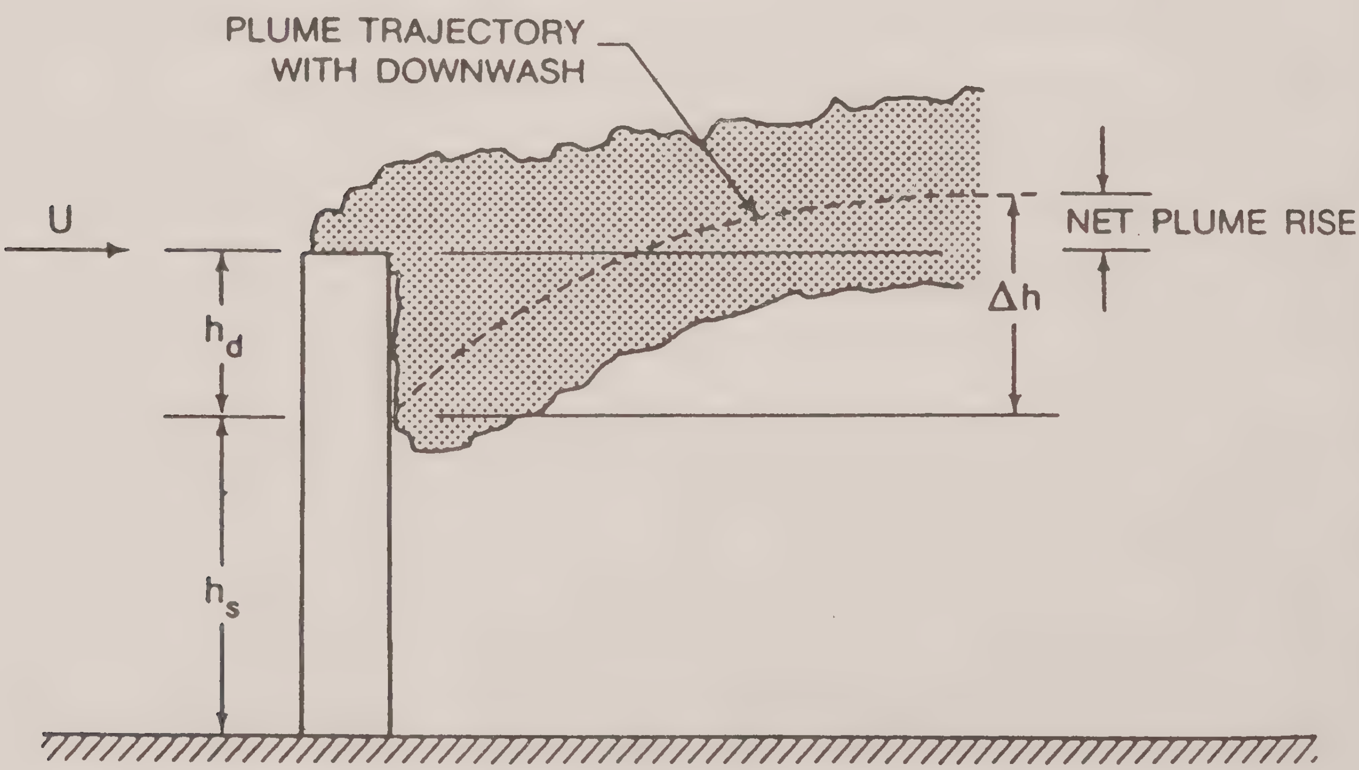
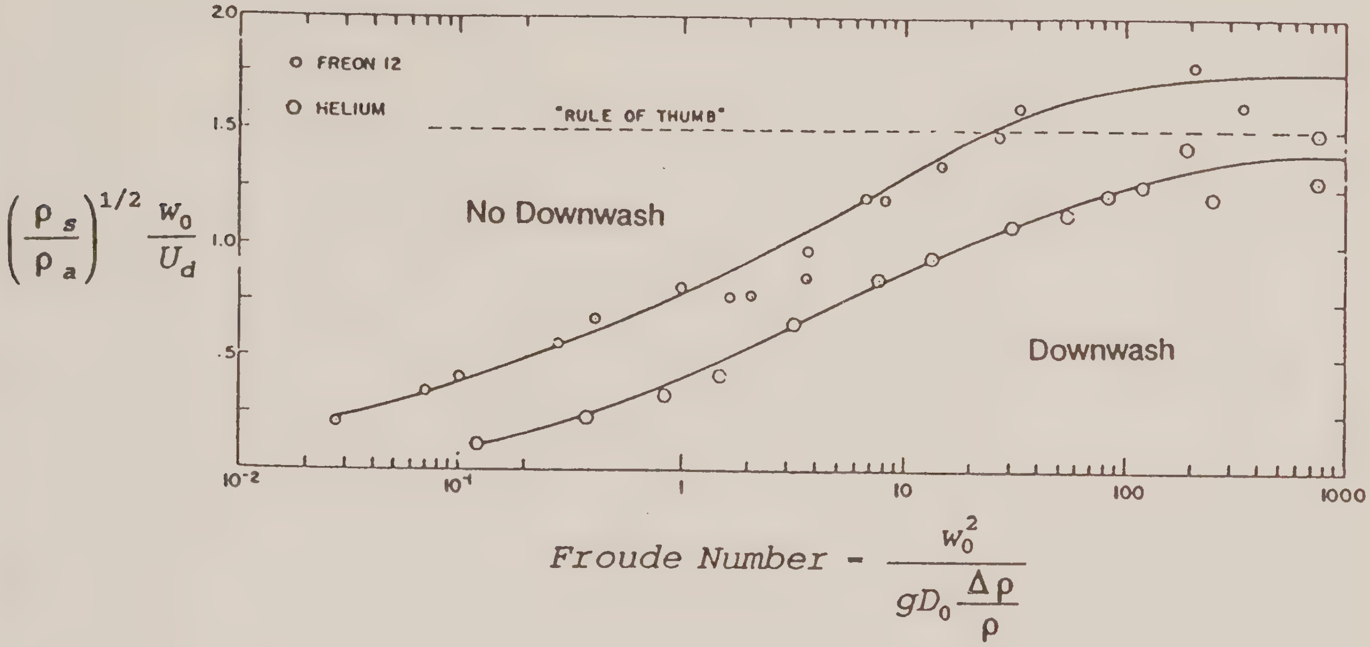


Figure 1: Diagram of Plume Downwash Around a Stack. Taken from ASHRAE (1993)



where D_0 = Chimney Stack Diameter

W_0 = Chimney Gas Discharge Velocity

U_d = Atmospheric Windspeed at Top of Chimney Stack

g = Acceleration Due to Gravity

ρ_a = Density of Ambient Air

ρ_s = Density of Flue Gases

$$\frac{\Delta\rho}{\rho} = \frac{\rho_a - \rho_s}{\rho_a}$$

Figure 2: Stack Discharge Conditions Required to Avoid Plume Downwash. Taken from Snyder (1974).

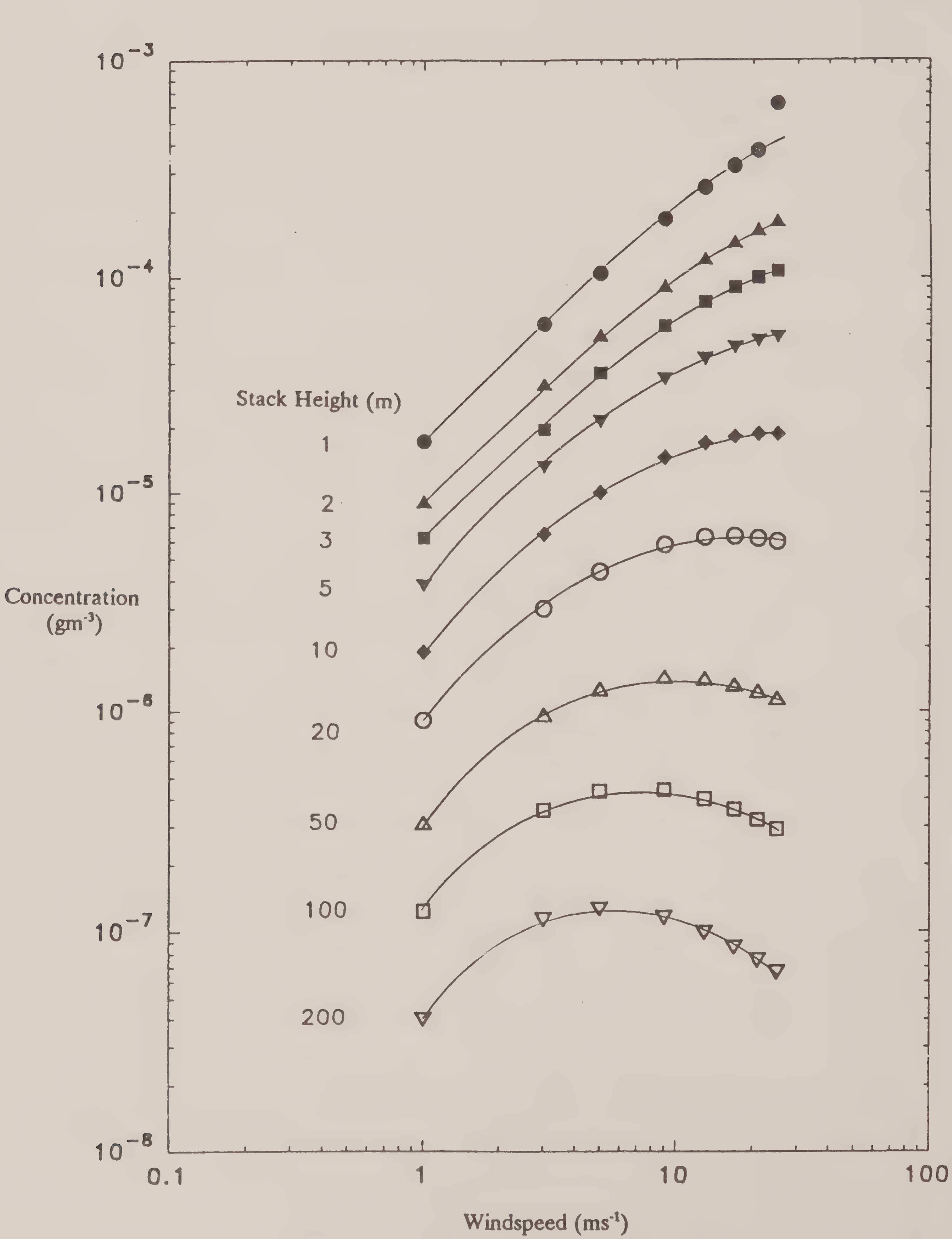


Figure 3: Example of Dispersion Calculations for Guidance Note D1, for a Heat Release of 10MW and a Unit Discharge Rate of 1gs-1. Taken from Hall and Kukadia (1993).

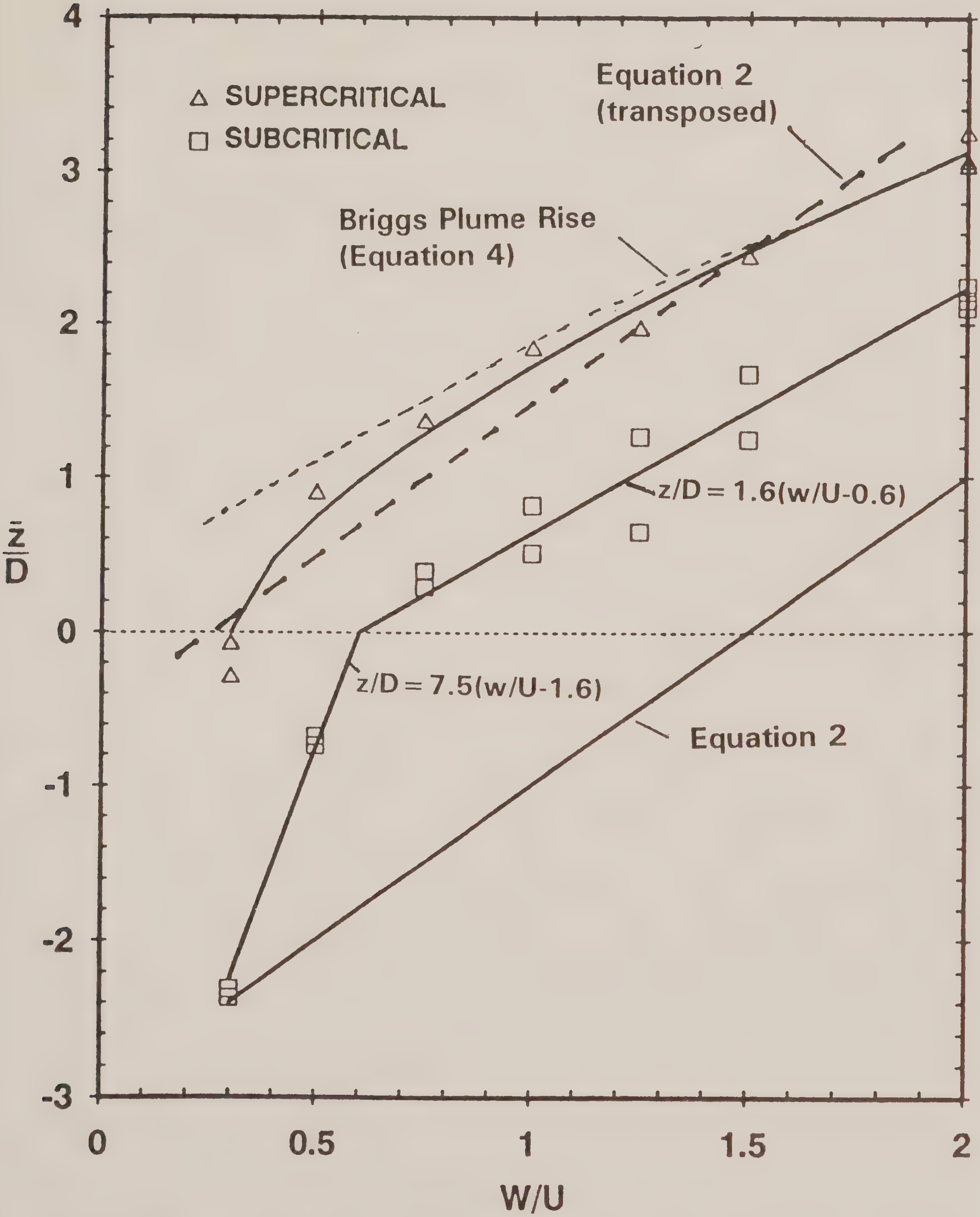


Figure 4: Plume Centroids Just Downwind of a Stack Under Downwash Conditions. Measured at a Distance of 30 Stack Diameters. Taken from Snyder and Lawson (1991).

ATMOSPHERIC BENZENE CONCENTRATIONS NEAR PETROL SERVICE STATIONS IN MIDDLESBROUGH

Sean Little BSc(Hons) MCIEH
and
Dr Geoff Cram CChem, FRSC
Leeds Metropolitan University

Abstract

Since the early part of this century, it has been recognised that benzene is both toxic and carcinogenic to man, and as the health effects of exposure to high concentrations are known, the risks of exposure to low levels over long periods remain of concern.

As benzene is a natural constituent of petrol, employees at petrol service stations and the majority of the general public will be exposed to benzene at these sites, yet there has been little investigation of atmospheric concentrations at sites in the UK or of the impact on the environment and man.

This paper establishes ambient benzene levels that could occur at a typical petrol station in the UK. Using porous-polymer diffusion tubes, thermal desorption and gas chromatography, mean time-weighted benzene concentrations of 1.6 ppb, 6.8 ppb, 7.8 ppb and 12.9 ppb were found at background, roadside, forecourt perimeter and dispensing pump locations respectively, within a range of 0.1 - 31.6 ppb.

The results are discussed and recommendations are made for reduction of benzene levels and for further investigation.

Introduction

The most significant release of benzene into the atmosphere originates from motor vehicle activities and the distribution of petroleum products, which account for up to 90% of all global benzene emissions (OECD 1986), allowing an estimated 48,500 tonnes to enter the atmosphere per year in the UK alone (DOE 1994). At petrol service stations, these emissions will occur as a result of evaporative emissions during replenishment of subterranean storage tanks, evaporative emissions during refuelling of vehicles and exhaust emissions from visiting motor vehicles.

The association between exposure to high benzene concentrations and cancer, particularly leukaemia, has been well established since the first reported case in 1928 (Delore & Borgomano). Probably the two most important studies are those of Vigliani (1976) and Askoy (1985), both of which conclude that the risk of leukaemia is higher at benzene concentrations as low as 25 ppm. At much lower levels, however, there remains a high degree of uncertainty as regards the dose-response relationship. Most studies find the significance of a higher than normal rate of leukaemia difficult to assess owing to varied histories of exposure to chemicals in each case history.

Attempts have also been made to link leukaemias with employees at petrol service stations. Jakobsson et al (1993) examined the risks of leukaemia for all employment groups in Sweden. They concluded that the only group that showed a significantly elevated risk was male petrol station attendants, with ten cases observed as opposed to 2.8

expected. It is noted, however, that practices in Sweden and throughout Europe have changed considerably and that petrol stations are now mostly self-service.

The benzene content of petrol was reduced to below 5% by volume in 1985 as a result of European Directive 85/210/EEC, and exhaust emissions for all new vehicles are being set at increasingly stringent levels as a result of frequent amendments to Directive 70/220/EEC. However, the ever-increasing vehicle population and subsequently greater activity at petrol stations means that pollution levels at these sites are at best being maintained, and may be increasing.

With little evidence to support a contrary opinion, the International Agency for Research on Cancer (1982) classified petrol vapours and exhaust fumes from vehicles as potential carcinogens and the World Health Organisation (1987) stated that "No safe level can be recommended for exposure to benzene", because of its carcinogenic properties.

In the USA, legislation has been introduced to control emissions during replenishment of storage tanks (Stage 1B controls) and during refuelling of vehicles (Stage 2 controls), in addition to reducing the benzene content of fuel to below 1%. Stage 1B vapour recovery controls will soon be in use throughout the UK having been adopted via EU Directive 94/63/EC, but no commitment has yet been made to introduce Stage 2 systems. The Directive is being implemented in the UK by an amendment to the *Environmental Protection (Prescribed Processes and Substances) Regulations 1994* which will make affected petrol service stations Part B processes for local authority air pollution control.

In 1994 a report by CONCAWE (the oil companies' European organisation for environmental and health protection) provided information on benzene levels at other sites around Europe. Although different sampling techniques were employed, this study indicated levels in the range of 0.5 - 37.2 ppb, with variations reflecting the relative sampling positions with respect to sources of emissions, such as dispensing pumps, storage tank vents and road traffic.

As no such investigations have been carried out in the UK, this study aimed to establish preliminary data of typical ambient benzene levels at petrol stations in this country. The study was carried out in November and December 1994.

Study Sample and Methodology

Two independent petrol stations in Middlesbrough were chosen to carry out this study, which represented typical sites throughout the UK. The two sites were very different in terms of siting, layout, commercial activity and equipment age; although petrol station A was significantly more modern than station B, neither had controls to prevent evaporative emissions.

Collection of benzene onto Tenax-filled passive diffusion sampling tubes was followed by thermal desorption (Perkin-Elmer ADT 50) to remove the benzene and analysis by gas chromatography (Perkin-Elmer 8410), which determined the amount of benzene by weight (μg). The sampling tubes had a calculated uptake rate of 1.3 ng ppm^{-1} min^{-1}.

Eight sampling tubes were positioned in and around each site, to assess benzene levels at background, roadside, forecourt perimeter and dispensing pump locations. The tubes were left in position for a period of 48 hours before collection and analysis, over six

monitoring phases to take account of the variations in concentration due to site activities, weather conditions and adjacent roadside traffic, giving a total of 96 samples. Figure 1 indicates the locations of the tubes at each site, which remained unchanged for each phase. Only three background samples were thought to be necessary as levels were being continuously measured at a permanent monitoring site controlled by the local authority. Also, a recent study had indicated expected background levels in Middlesbrough (Stevenson and Fernandes 1994).

This methodology was based on Health and Safety Executive (1985) guidelines to measure benzene (MDHS 50), which describes a methodology for a time-weighted average concentration of benzene for periods of between 10 minutes and 8 hours in a workplace atmosphere, and has been used successfully to measure outdoor concentrations over much longer periods. A recent hydrocarbon study in Middlesbrough left tubes in position for 2-week periods (Stevenson and Fernandes 1994).

During analysis, "spiked" samples containing a known quantity of benzene were also tested and spaced at random intervals throughout analysis of the unknown samples to check on the accuracy of the instrumentation.

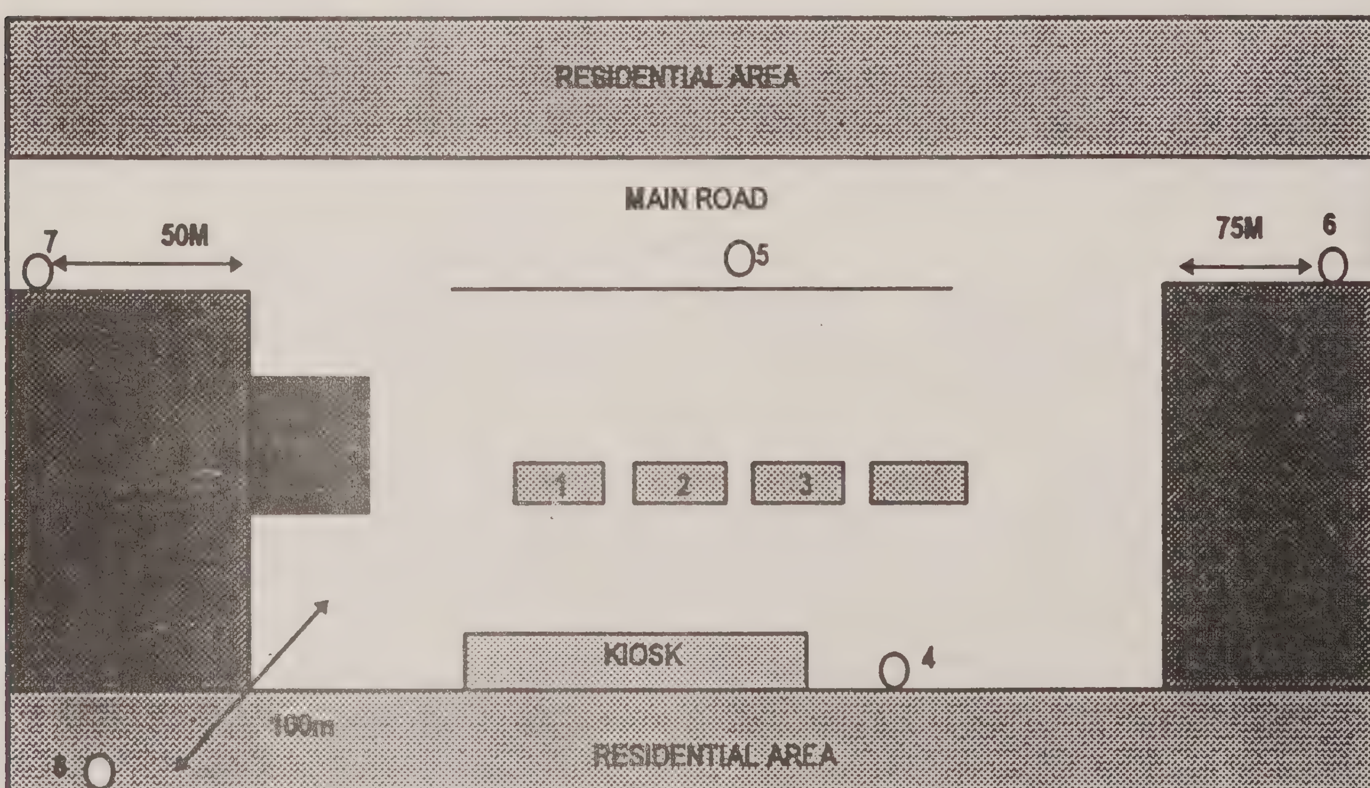
From the recorded weight of benzene found in each tube, the time-weighted average of atmospheric benzene concentration was calculated using the formula given by MDHS 50:

$$Concentration\ (ppm) = 1000(^{m}blank)/Ut$$

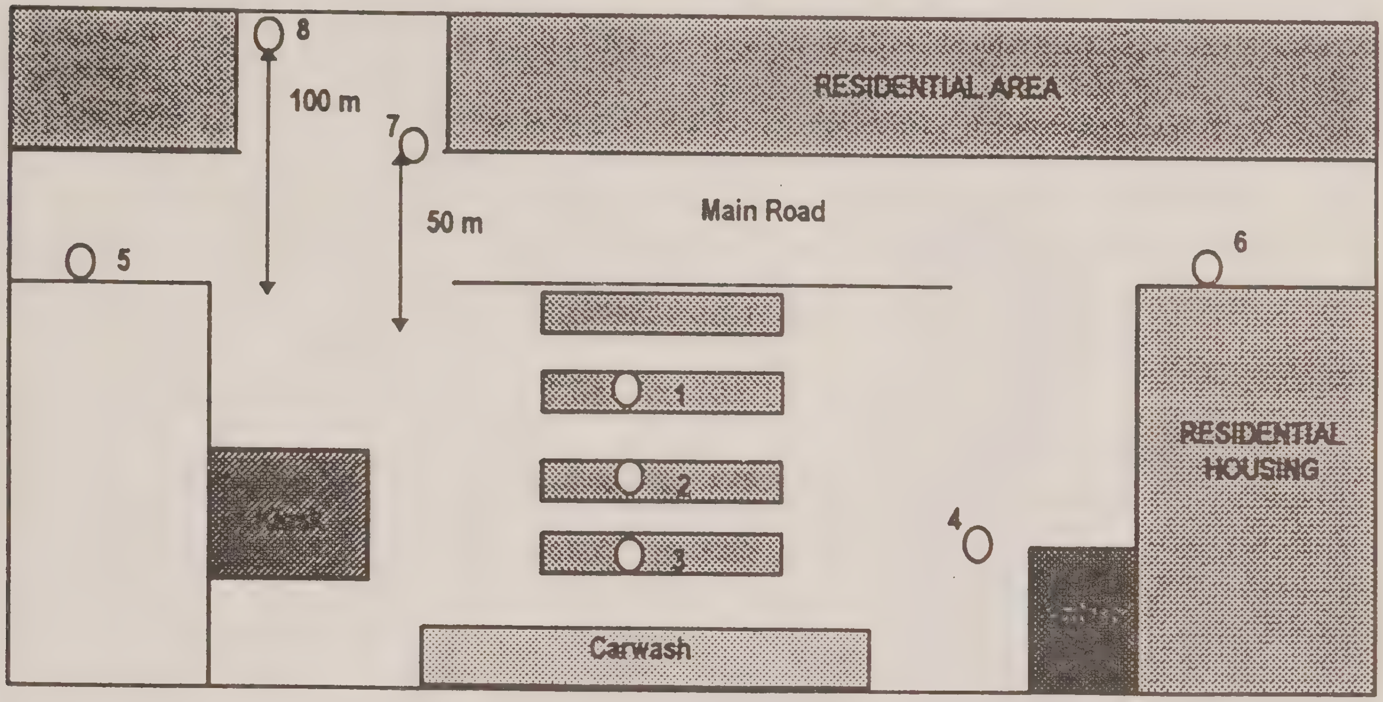
where m	=	weight (μg) benzene on sample tube
^{m}blank	=	weight (μg) benzene on blank tube
U	=	uptake rate (ng ppm^{-1} min^{-1})
t	=	monitoring period (min)

Figure 1. Layout of Petrol Service Stations and Sampling Locations (not to scale)

(a) Service Station A



(b) Service Station B



Investigation Results

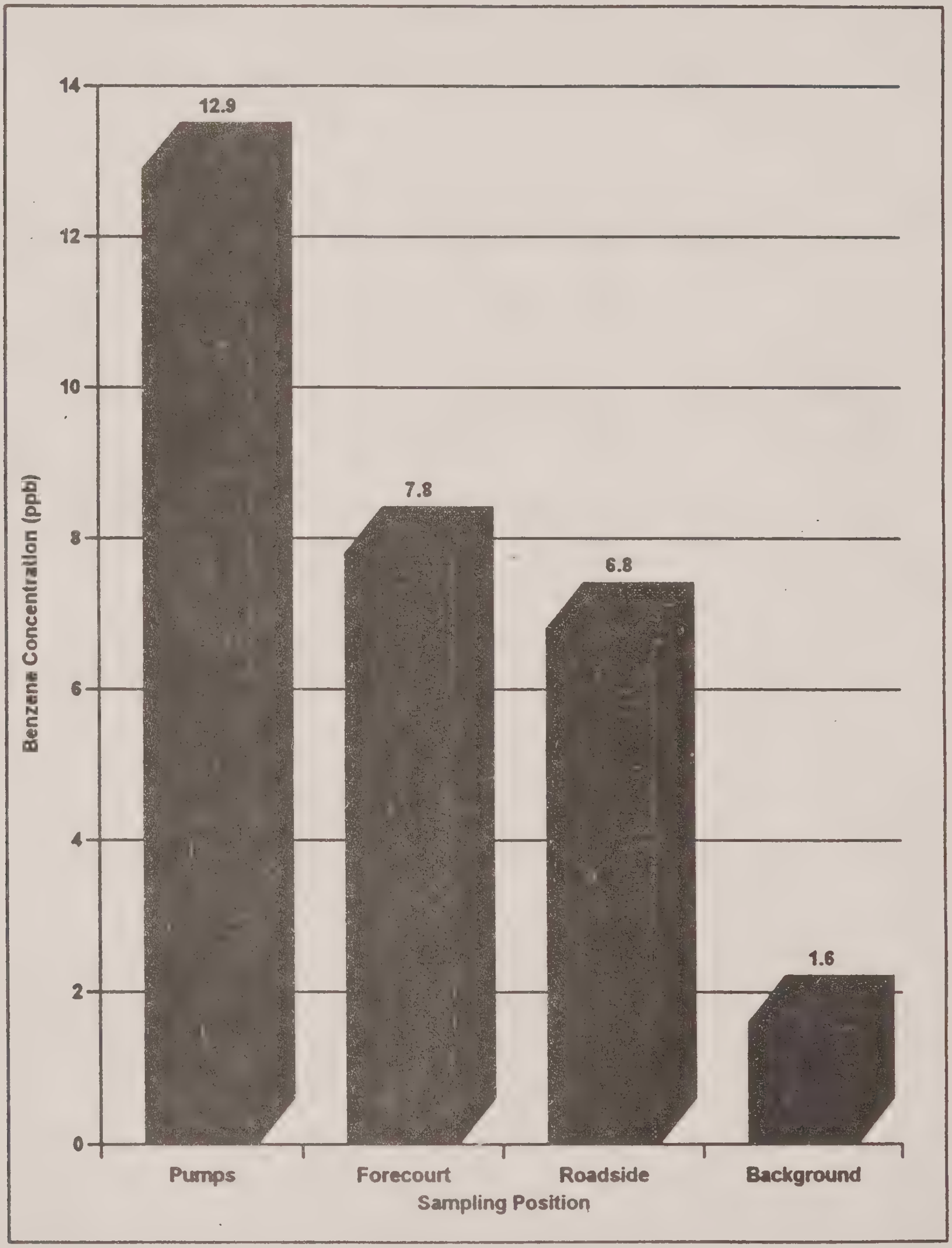
The arithmetic mean is considered to be the most reliable form of assessing long-term atmospheric pollution data, to take account of the large variations that may occur from any individual monitoring positions and during each phase. Peak concentrations were, however, noted with a high of 31.5 ppb (at service station A) and a background low of 0.1 ppb. A general overall increase in levels was also noted during Phase 3, which coincided with the annual economic budget and possible consumer anticipation of heavy fuel price rises. Mean benzene concentrations during all four measurement phases for background, roadside, perimeter and forecourt sites are given in Table 1.

Table 1. Mean Benzene Concentrations (ppb)

	Petrol Station A				Petrol Station B			
	B/G	R/S	P	F	B/G	R/S	P	F
Phase 1	1.0	3.2	4.1	7.1	1.2	1.7	3.9	10.9
Phase 2	1.1	11.8	13.5	8.6	1.0	2.4	8.3	9.8
Phase 3	2.3	14.0	14.2	28.5	1.7	8.9	28.5	15.9
Phase 4	1.1	4.6	4.3	12.3	1.3	1.3	7.6	10.2

Key: B/G – Background
R/S – Roadside
P – Forecourt perimeter
F – Forecourt pumps

Figure 2. Overall Mean Atmospheric Benzene Concentrations at Middlesbrough Petrol Service Stations



As the results at Figure 2 indicate, the lowest overall mean concentrations were found at background locations (1.6 ppb) with the highest mean concentrations occurring at the dispensing pumps (12.9 ppb), with roadside and forecourt perimeter levels midway between (6.8 ppb and 7.8 ppb).

Background levels were consistent with those recorded at the permanent air quality monitoring site within Middlesbrough (mean 1.6 vs 1.3 ppb) and also with that of Stevenson & Fernandes (mean 0.9 ppb) measured in Middlesbrough in 1994. Roadside levels were found to be over three times higher than the previous survey (mean 6.8 vs 2.0

ppb), probably as a result of taking measurements immediately adjacent to the site rather than general roadside levels.

The results were reasonably consistent with the CONCAWE study at sites in other European countries between 1990 and 1992, recording mean background, roadside and forecourt levels of 2.5 ppb, 4.4 ppb and 6.2 ppb respectively, within a range of 0.5 - 37.2 ppb. It should be noted that different sampling techniques were employed by each study, although a field evaluation of both methods (active vs passive sampling) indicated that there should be no significant differences betwen results obtained by the two methods (Brown et al 1981).

Conclusions

Sampling of atmospheric benzene concentrations using passive sampling tubes, based on the methodology of HSE MDHS 50, proved to be a satisfactory technique for establishing outdoor benzene concentrations over longer exposure periods. Compared with studies by CONCAWE, Stevenson & Fernandes and the continuous monitoring system within Middlesbrough, this technique provided useful data from which the following conclusions were drawn:

- Ambient mean daily benzene concentrations at petrol stations will be, on average, in the range of 8 - 13 ppb, although this will vary considerably from day to day as a result of many variables, including weather conditions, commercial activity at the site and the volume of road traffic adjacent to the site.
- In general, benzene levels were in the rank order expected, with highest mean levels at the dispensing pumps and the lowest at background locations. The results indicated that petrol station activities could have a significant impact on the immediate local environment, particularly if sited in a built-up urban area.
- Typical forecourt levels were found to be, on average, up to six times higher than expected background levels and up to five times roadside levels measured away from petrol stations.

Discussion and recommendations

Although the link between benzene and cancer is no longer disputed, there is still inconsistent scientific, medical and epidemiological evidence for the dose-response relationship of exposure at low concentrations. Furthermore, the risks associated with exposure over long periods is also disputed. As a result, those industries responsible for the majority of man-made benzene emissions have historically argued that legislative controls would be unfair, as they would demand a great deal of financial and technological investment for a questionable improvement in the impact of benzene on man. The Institute of Petroleum may soon be able to shed new light on the risks of exposure to low levels of benzene as they are due to announce the results of a long-term epidemiological study.

This study indicates that ambient benzene levels around petrol stations may exceed the running annual average of 5 ppb recommended by the Expert Panel on Air Quality Standards of the DoE (EPAQS, 1994), and would certainly exceed the lower level of 1 ppb running annual average which EPAQS recommend should be adopted as a long term aim.

This recommendation, if accepted by Government and included in the National Air Quality Strategy now being prepared by the Secretary of State as a result of the *Environment Act 1995*, could have far-reaching implications for local authorities and industry.

The technology is available to make a significant impact on the reduction of benzene emissions into the atmosphere and has been used in the USA and other countries for some time. Stage 1 and Stage 2 vapour recovery systems installed at distribution terminals and petrol service stations could prevent up to 44,000 tonnes of benzene vapours entering the atmosphere (DOE 1994) (CONCAWE 1990), not accounting for the reduction of the content of benzene in fuel to below 1%. The following recommendations are therefore made:

- Legislation to reduce the benzene content of petrol to below 1% by volume, as recommended by the Royal Commission on Environmental Pollution (1994).
- Although Stage 1 vapour recovery systems will soon be introduced, Stage 2 controls are arguably a more important measure for minimising public exposure to benzene, particularly when refuelling vehicles. The compulsory introduction of Stage 2 controls via legislation will be necessary if air quality targets are to be achieved in the region of petrol stations.
- A more comprehensive study of benzene levels at petrol service station sites in the UK to establish their effect on local air quality and public exposure.

Acknowledgement

Sean Little acknowledges the support of Middlesbrough Borough Council during the placement year of his Environmental Health honours degree.

References

Askoy, M. (1985). *Malignancies due to occupational exposure to benzene.* American Journal of Industrial Medicine, **7:** 395-402.

Brown, R.H. et al (1981). *Performance of tube-type diffusive sampler for organic vapours in air.* Analytical Proceedings, vol 18, **5:** 205-208.

CONCAWE (1990). *VOC emissions from gasoline distribution and service stations in Western Europe - control technology and cost-effectiveness.* Report no. 90/52. Brussels, CONCAWE.

CONCAWE (1994). *A preliminary study of ambient air concentrations of benzene around service stations and distribution terminals in Europe.* Report no. 94/53. Brussels, CONCAWE.

Delore, P. and Borgomano, C. (1928). *Acute leukaemia following benzene poisoning. On the toxic origin of certain serious leukaemias and their relation to serious anaemias.* Arch. mal. prof. Med. trar. secur. soc. **24:** 867-869.

Department of the Environment (1994). *Expert panel on air quality standards - benzene.* London, HMSO.

EPAQS (1994). *Recommendations for ozone and benzene Air Quality Standards*. London, HMSO.

Health and Safety Executive (1985). *Laboratory method using porous-polymer diffusion samplers, thermal desorption and gas chromatography (MDHS 50 - Benzene)*. Handbook of occupational hygiene (Instalment 19). Volume 13, **3:** 303-310. London, HMSO.

International Agency for Research on Cancer (1982). *Monographs on the evaluation of carcinogenic risks to humans.* **29:** 93-148.

Jakobsson, R. et al (1993). *Acute myeloid leukaemia among petrol station attendants.* Archives of environmental health, volume 48 **4:** 255-259.

Organisation for Economic Cooperation and Development (1985). *Environmental monograph no. 5. Control of toxic substances in the environment - benzene*. Paris, OECD.

Royal Commission on Environmental Pollution (1994). *Eighteenth report - transport and the environment.* London, HMSO.

Stevenson, K.J. and Fernandes, A. (1994). *A study of hydrocarbon concentrations in the Middlesbrough area.* Didcot, AEA Technology.

Vigliani, E.C. (1976). *Leukaemia asociated with benzene exposure.* Annals of the New York Academy of Sciences, 271: 143-151.

World Health Organisation (1987). *Air quality guidelines for Europe - benzene.* Copenhagen, WHO.

Note: Results from a study published by the Institute of Petroleum on 1 September 1995 are summarised in the "Update" section of this issue of *Clean Air*.

A PRELIMINARY STUDY OF AN OZONE EPISODE IN LATE JUNE 1995 IN THE UNITED KINGDOM

David Muir
Senior Scientific Officer
Bristol City Council Health & Environmental Services

Abstract

An analysis is made of ozone concentrations at the national network sites (both AUN and rural) with the addition of two local authority sites in the Bristol area for the period 26 to 30 June 1995. This analysis is complemented by a simple analysis of wind directions across the United Kingdom for the same period. The 8 hour running average concentrations are compared with the standard recommended in 1994 by the Expert Panel on Air Quality Standards. It was found that this recommended standard was exceeded on many occasions at rural sites and on a number of occasions at urban sites as would be expected during a period of hot sunny weather. It was also found that it is probable that many of these exceedances were the result of ozone generated from precursors originating in the United Kingdom rather than in Northern Europe as has been the case in the past.

KEYWORDS: Ozone, meteorology, air quality standards.

Introduction

The week Monday 26 to Friday 30 June 1995 was characterised by hot, sunny weather and generally easterly winds, conditions which have on many occasions resulted in elevated concentrations of ozone, in particular at rural sites remote from ozone sinks such as nitric oxide from road traffic. Results from Bristol City Council's Blaise Castle site situated on the northern fringes of the city suggested that ozone concentrations had risen markedly during this period although not to the same extent as during the episodes of summer 1990. Provisional data for ozone for both the Automated Urban Network (AUN, formerly EUN) was obtained from AEA Technology's National Environmental Technology Centre (NETCEN) at Culham for the period April to June 1995 to permit a wider study of this episode as was data from Northavon District Council's newly commissioned site at Badminton. Wind direction information for the week was obtained from the Met Office to allow some estimation to be made of the trajectories followed by the air masses en route to the various sites.

Methodology

Initially eight hour running average concentrations for the period 26 to 30 June were calculated for all sites. These were then plotted as time series and compared with the UK Expert Panel on Air Quality Standards (EPAQS) recommended standard of 50 ppb expressed as an eight hour running average. This enabled detailed comparisons to be made between sites for this particular week. The number of occasions on which the EPAQS recommendation was exceeded was also calculated both for this period and for the period April to June 1995. In order that further comparisons could be made the number of occasions on which the World Health Organisation (WHO) lower eight hour average guideline value of 50 ppb calculated for the periods 00:00 to 07:59, 08:00 to 15:59 and

16:00 to 23:59 was also calculated for each site. The wind direction data was also examined and trajectories estimated at a number of locations to indicate possible paths for the ozone precursors. Although data on ozone concentrations are presented for 26 to 30 June to illustrate the build up of concentrations, only the last three days are considered so far as detailed analysis is concerned. Comparisons are also made between the three sites in the vicinity of Bristol. A further, brief, comparison is made between the EPAQS and WHO criteria for eight hourly ozone concentrations.

Results

The full list of sites examined is given in Table 1 together with the abbreviation used in some of the graphs shown later. The locations of the network sites are shown in Figure 18 and detail of the Bristol area sites in Figure 19.

Table 1

Site	Comment	Site	Comment
Aston Hill (AH)		Hull Centre (Hu)	Urban
Belfast (Bel)	Urban	Ladybower (Lb)	Data missing
Bexley (Bex)	Urban	Leeds Centre (Le)	Urban
Birmingham Centre (Bir C)	Urban, data missing 26 - 30/6/95	Leicester Centre (Lei)	Urban
Birmingham East (Bir E)	Urban	Lullington Heath (LH)	
Bottesford (Bot)		Liverpool Centre (Liv)	Urban
Bridge Place (Bri)	Urban, data missing 26 - 30/6/95	Lough Navar (LN)	
Bristol Centre (Bris)	Urban	Middlesbrough (Mid)	Urban
Bush (Bush)		Newcastle (Ne)	Urban
Cardiff Centre (Car)	Urban	Sibton (Sib)	
Central London (Cll)	Urban	Southampton Centre (So)	Urban, data missing 26 - 30/6/95
Edinburgh Centre (Ed)	Urban	Strath Vaich (SV)	Remote rural
Eskdalemuir (Esk)		Wharleycroft (Wh)	
Great Dun Fell (GDF)	Remote rural	Yarner Wood (YW)	
Glazebury (Gl)		Badminton (Bad)	Northavon District Council
Harwell (Har)		Bristol Blaise Castle (Bla)	Suburban, Bristol city council
High Muffles (HM)			

The time series plots for the running eight hour average concentrations of ozone at a number of the sites are shown in Figures 1 to 12. The number of 8 hour periods on which the EPAQS recommended standard was exceeded for both the period April to June 1995 and the week 26 to 30 June 1995 are shown in Figures 13 and 15. The number of occasions on which the lower eight hour WHO guideline was exceeded for both the period April to June 1995 and the week 26 to 30 June 1995 are shown in Figures 14 and 16. Midday wind directions for the 28, 29 and 30 June 1995 and the approximate locations of eight of the network sites of particular interest are shown in Figure 17.

INTERPRETATION

The National Picture

The results from various sites show that this was not a uniform episode as has sometimes been the case. It is not to be expected that the urban sites would show exceedances of the EPAQS recommended standards to the same extent as the rural sites, even in the most extreme episodes, due to the presence of ozone sinks, notably nitric oxide. It is also less likely that an episode would be as intense in the more northerly cities due to lower temperatures. Even so the EPAQS recommended standard was exceeded at urban sites in Bexley, Birmingham (both sites) Bristol, Cardiff, London, Leicester and Liverpool. Of all the sites the greatest number of exceedances was at Aston Hill but examination of the time series plot suggests that this was in part due to high nocturnal concentrations suggesting the influence of the location of the site at a height of 370 metres. This is also the case with Great Dun Fell (altitude 847 metres) which had the third highest number of exceedances of the EPAQS recommended standard.

In 1990 the sites which were most particularly associated with ozone episodes are Aston Hill, Bottesford, Great Dun Fell, Harwell, Ladybower, Lullington Heath, Sibton and Yarner Wood (criterion maximum eight hour average >95 ppb)[1]. It is instructive then to look at the results from these sites in some detail. At Aston Hill as has been stated there is probable influence of altitude on the night of 29/30 June but there is clear evidence of photochemical ozone formation on all three days of interest. The influence of altitude is even more marked at Great Dun Fell although at the nearby Wharleycroft site (altitude 206 metres) photochemical influence was evident. At Bottesford there was very little activity although the EPAQS recommendation was exceeded marginally on 30 June and clear diurnal patterns were seen. At Harwell the EPAQS recommendation was exceeded on all three days although the exceedance on 30 June was the most marked. It is not possible to wholly analyse the sequence of events at Ladybower as some results in the crucial periods were missing but it is certain that there was an episode, probably very similar to the sequence of events at Harwell. There was very little activity at Sibton until 30 June when the EPAQS recommendation was exceeded.

The two most interesting sites to consider in this sequence, however, are Lullington Heath and Yarner Wood. Both sites have consistently recorded high concentrations of

1. 95ppb as an eight hour average was selected as the cut off point as the Photochemical Oxidants Review Group (PORG) database from which this data was obtained uses the WHO periods for calculating the eight hour averages so these sites would certainly exceed 100 ppb as a running average.

ozone with the maximum eight hour average (WHO categories) usually being close to if not greater than 100 ppb even in relatively photochemically inactive years. During this period there was a very consistent sequence of events at Yarner Wood where there were marked exceedances of the EPAQS recommended standard on all three days under consideration. At Lullington Heath, however, the familiar sequence of events during an ozone episode of a steady increase in concentrations day after day until the end of the episode was not followed. Instead after increases from Monday to Tuesday to Wednesday there was a decrease in concentrations from Wednesday to Thursday which was characteristic of the ending of an episode. This was then followed by a Friday when there was little difference between concentrations at Lullington Heath and Yarner Wood.

Possible reasons for the lack of activity at sites such as Bottesford and Sibton and more so the unusual sequence of events at Lullington Heath emerge when the wind directions are examined. Until 30 June Bottesford and Sibton were receiving air from over the North Sea which might be expected to be relatively free of the full range of ozone precursors so that even with conditions which would favour ozone formation the amounts formed would be unlikely to be significant. On 30 June, however, these sites started to receive air from Central England and the eight hour running averages at both sites exceeded 50 ppb although not by a large amount.

The sequence of events at Yarner Wood was reasonably straightforward as on all three days the site was receiving air from areas where it could reasonably be expected to pick up ozone precursors. There is still a point to note in that on 28 and 29 June the air mass appears to have traversed the South East of England from the North Sea with little if any evidence of the continental influences which have been so characteristic of ozone episodes such as that of August 1990. On 30 June it appears more likely that the continental influences were effective although the possibility also exists that much of the ozone measured here could have been the result of UK emissions of precursors.

The situation at Lullington Heath reflects the suggested scenario at Yarner Wood to some extent but also suggests to a greater extent the contribution of UK sources of ozone precursors to this episode. As is shown in Figure 17 on 28 June Lullington Heath was receiving air from a direction somewhat North of North East. This implies that the air was traversing the eastern side of the London area and acquiring sufficient quantities of ozone precursors to cause a relatively small but clear exceedance of the EPAQS recommended standard. By 29 June the wind direction had moved to slightly East of North East and the air received by Lullington Heath would now in all probability be the relatively clean air from the North Sea. On this day the running eight hour average ozone concentration reached a maximum of 44 ppb[2] whereas at Yarner Wood the maximum was greater than 80 ppb. On 30 June the air reaching Lullington Heath was now traversing parts of Northern Europe and the running eight hour average ozone concentration reached 100 ppb and was marginally higher than at Yarner Wood.

There appears to have been little or no indication from predictive models that the meteorological conditions forecast for this week would result in an ozone episode.

2. As was the case at Sibton on the East Anglia coast which was also receiving air from the North Sea

The Local Picture

Data for three sites located within a circle with a diameter of approximately 15 miles in the Bristol area is included to illustrate the effects of ozone sinks in urban areas and the fact that these sinks can be swamped at times when ozone concentrations are relatively high. At all times ozone concentrations at the rural Badminton site, newly installed by Northavon District Council, were higher than at the suburban Blaise Castle site on the northern fringes of Bristol. Ozone concentrations at this site were also usually higher than at the Bristol Centre AUN site except on 30 June when there was a noticeable peak at the Bristol Centre site. There is no immediate explanation of this event but it is possible to speculate that the local wind direction was such that air was traversing the City from a South Easterly direction and was being more affected by ozone sinks in its longer passage to Blaise Castle.

A Brief Comparison of the EPAQS Recommended Standard and the WHO Guideline

The EPAQS and WHO criteria are both based on eight hourly averaging periods. There is a fundamental difference between them in that the former is based on a running average whereas the latter is based on discrete eight hour periods. The EPAQS recommended standard is therefore a stricter standard than the current WHO guideline as peak ozone concentrations are picked up in more eight hour windows. This does perhaps suggest that the EPAQS recommended standard might be better as an effects based standard. Figures 13 to 16 illustrate the exceedances of the two criteria at all the sites for which data is available for both the period April to June 1995 and for the five days under particular consideration here. It is clear that there are some broad similarities in that those sites where the EPAQS recommendation is exceeded most often tend to have more exceedances of the WHO guideline but there appear to be a considerable number of occasions where the former might be exceeded but the latter is not.

These Figures also illustrate the differences between the urban and rural sites and the possible influence of latitude on ozone concentrations. At the urban sites the lowest numbers of exceedances of the EPAQS recommended standard were recorded at Belfast, London (Bridge Place), Edinburgh, Hull, Leeds, and Newcastle with Central London, Liverpool and Middlesbrough only slightly higher. It is not surprising that the two central London sites fall into this group as the concentrations of nitric oxide ozone sinks are likely to be higher here. The remainder are the most northerly of the network sites.

Conclusions

There was a clear ozone episode at the end of the final week of June 1995. It was not an episode on the scale of that of August 1990 and even less so than the summer of 1976 but it was still significant. Current forecasting models do not appear to be able to predict unusual episodes of this nature. This is a matter which needs to be addressed.

This preliminary analysis of this episode and of the previous three months demonstrates that, at least in the southern half of the United Kingdom ozone episodes can affect the central areas of cities and that concentrations of ozone there can, on occasions, be almost equal to those in the surrounding rural areas.

The most important piece of evidence to emerge from this preliminary analysis is that it suggests that it is possible for an ozone episode to be caused by ozone precursors generated wholly within the United Kingdom. This runs somewhat counter to the statement that the reason for the standard recommended by the Expert Panel on Air Quality not being adopted was that tropospheric ozone was a problem which could **only** be addressed by international action. The increase in **background** tropospheric ozone is clear and can only be addressed by international action. In the case of the majority of ozone episodes it is clear that there is a very large contribution from continental sources of ozone precursors but this study does begin to suggest that action on United Kingdom emissions of these precursors could reduce the severity of such episodes and might bring about some reduction in the overall number of episodes by making episodes such as that described here less likely to occur.

Acknowledgements

The author would like to thank Geoff Broughton of National Environmental Technology Centre and John Law of Northavon District Council for the provision of ozone data and Adrian Buckland of the Meteorological Office for assistance with the wind data. Thanks are also due to Dr. Geoff Dollard and John Stedman of NETCEN and to Dr. Duncan Laxen of Air Quality Consultants for helpful comments.

References

Ozone in the United Kingdom 1993, Third Report of the United Kingdom Photochemical Oxidants Review Group, ISBN 0-7058-1683-4, Department of the Environment, 1993.

Ozone, 2nd report of the Expert Panel on Air Quality Standards, ISBN 0-11-752873-0, HMSO, 1994.

Air Quality Guidelines for Europe, ISBN 92-890-1114-9, World Health Organisation, 1987.

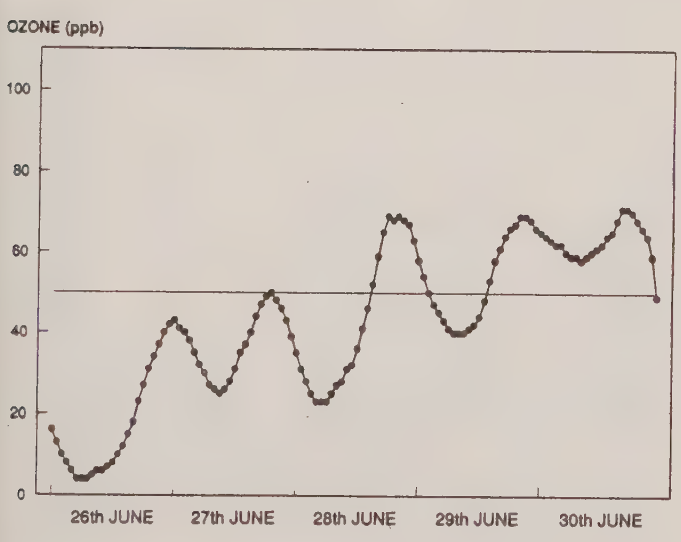


Figure 1: Aston Hill

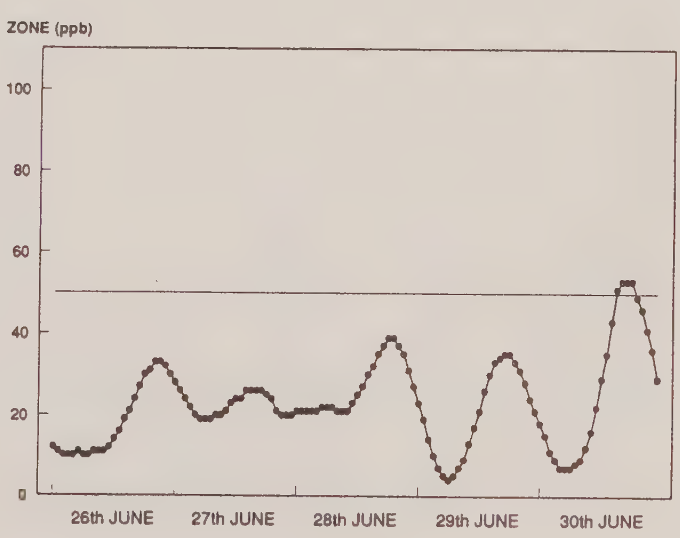


Figure 2: Bottesford

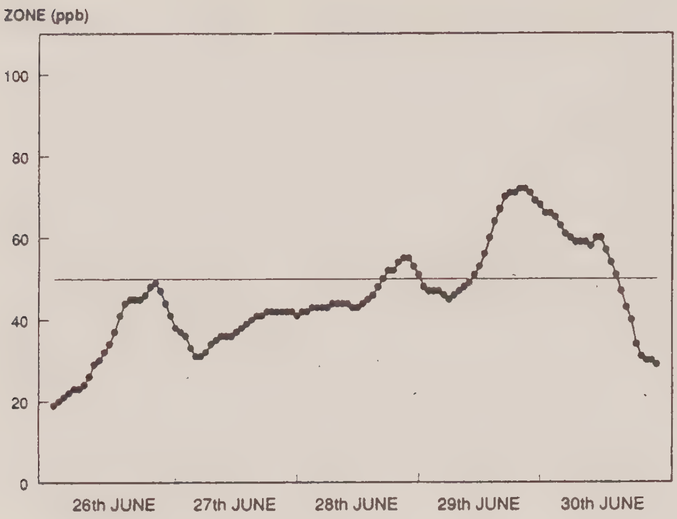


Figure 3: Great Dun Fell

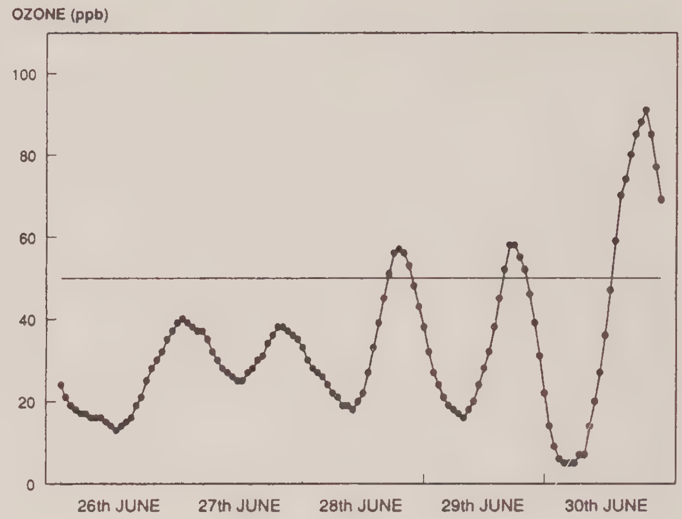


Figure 4: Harwell

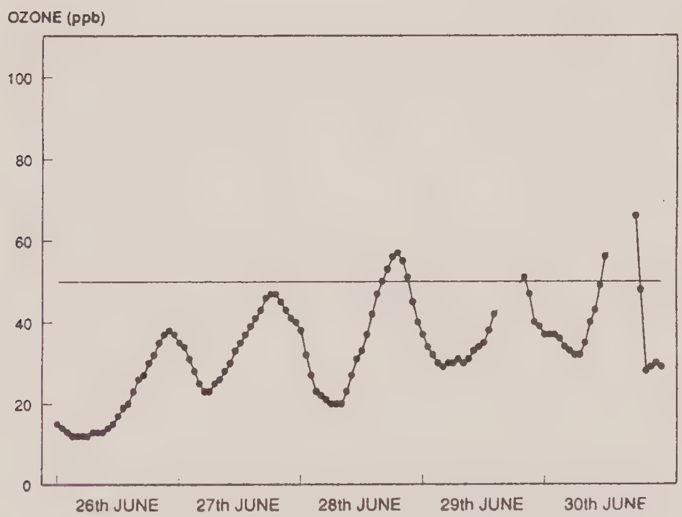


Figure 5: Ladybower

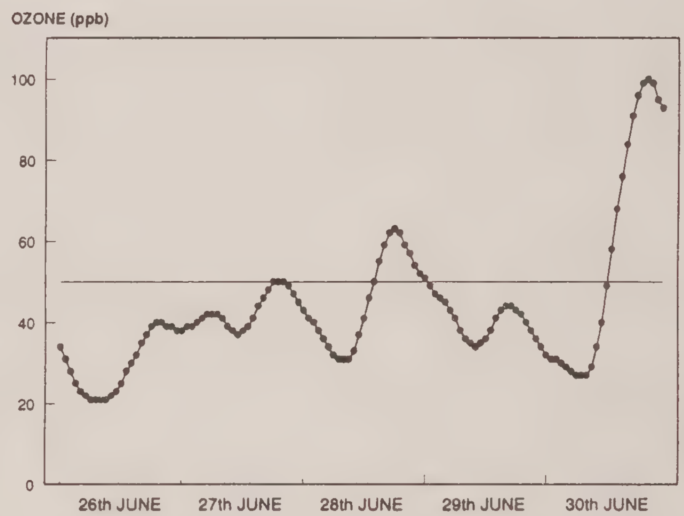


Figure 6: Lullington Heath

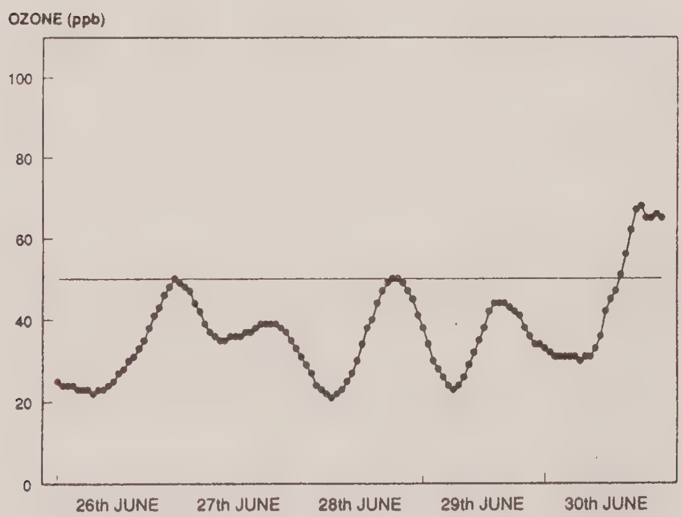


Figure 7: Sibton

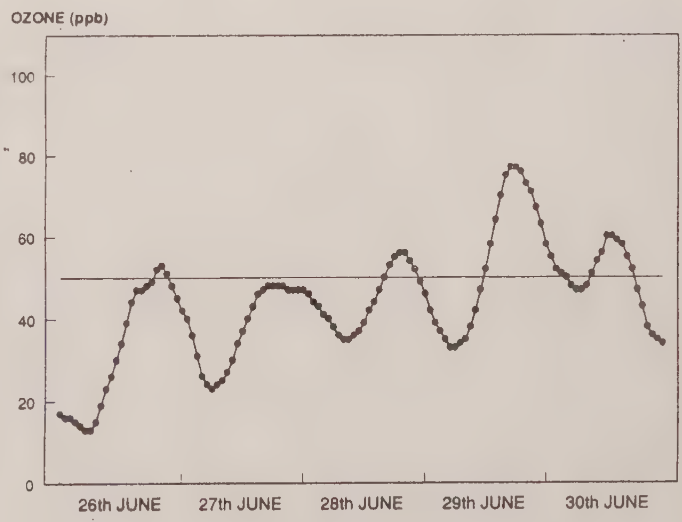


Figure 8: Wharleycroft

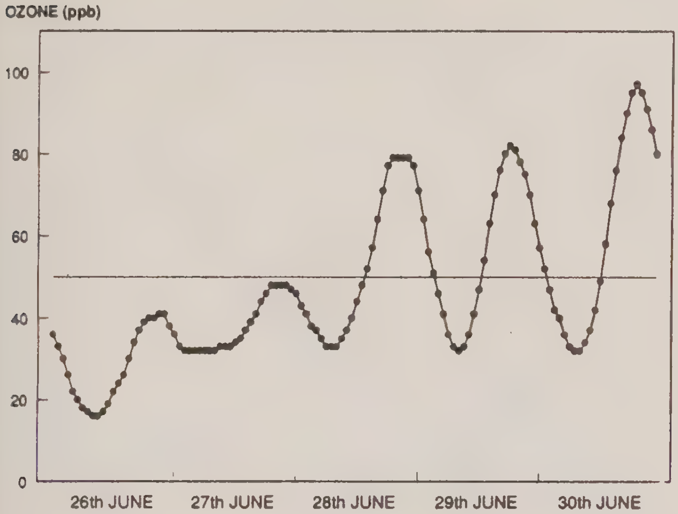


Figure 9: Yarner Wood

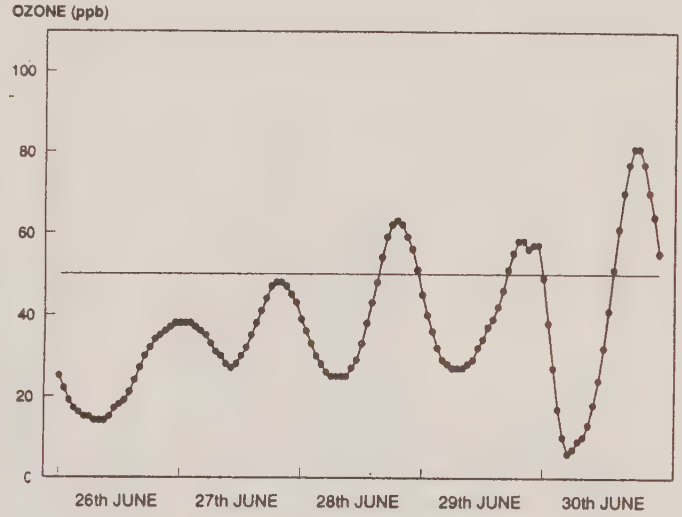


Figure 10: Badminton

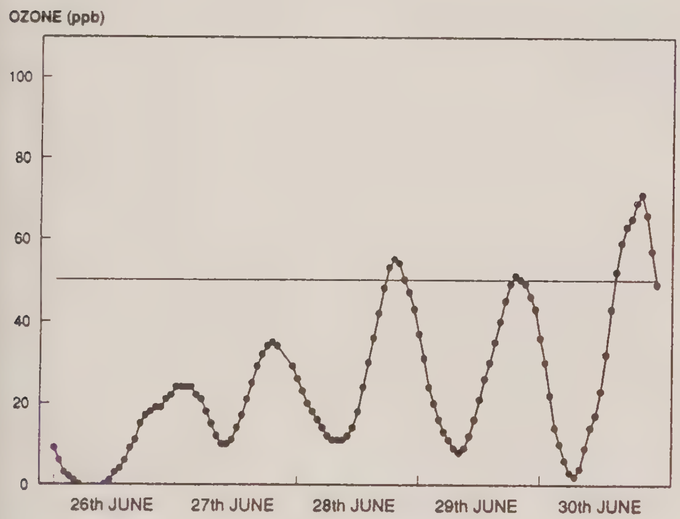


Figure 11: Bristol Blaise Castle

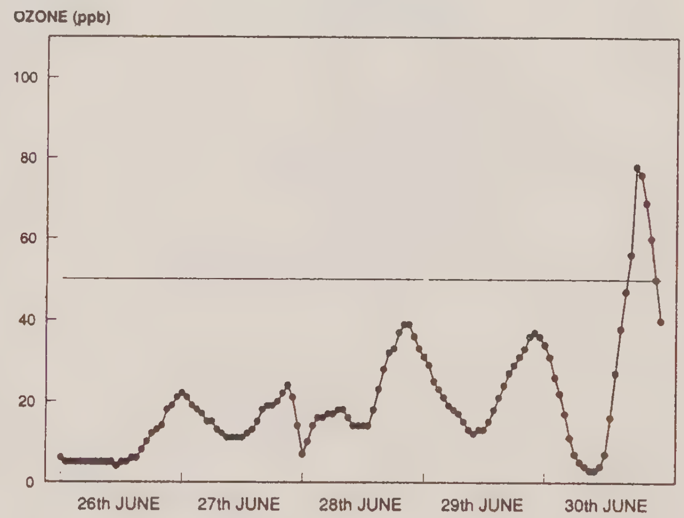


Figure 12: Bristol Centre

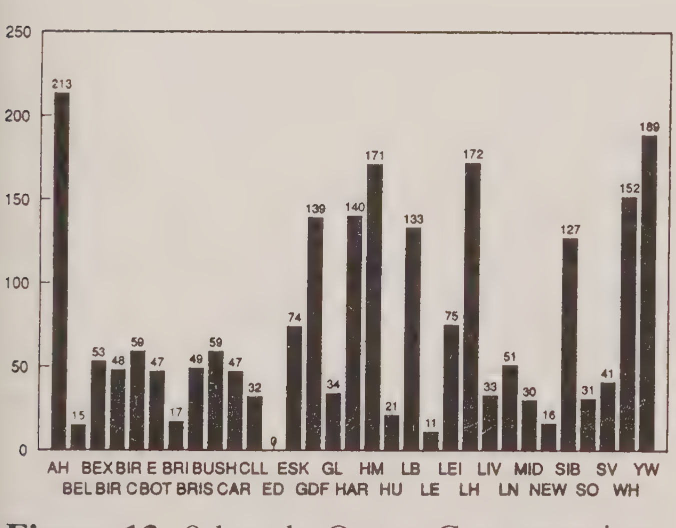


Figure 13: 8-hourly Ozone Concentrations Exceedances of 50 ppb (April - June 1995)

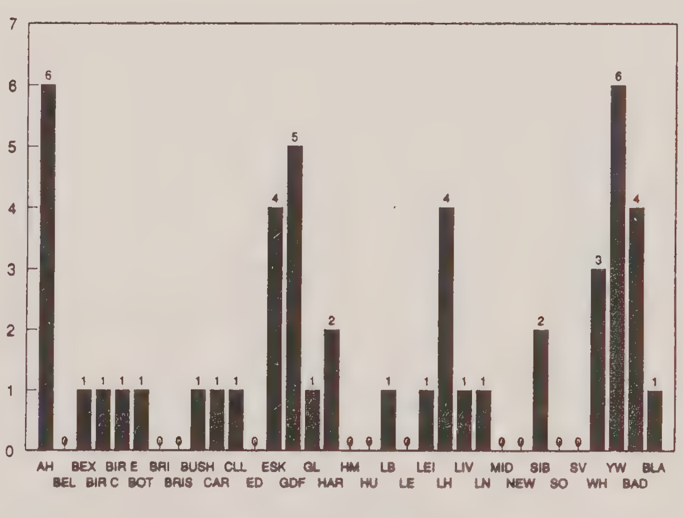


Figure 14: 8-hourly Ozone Concentrations Exceedances of WHO 50 ppb Guideline (26-30 June 1995)

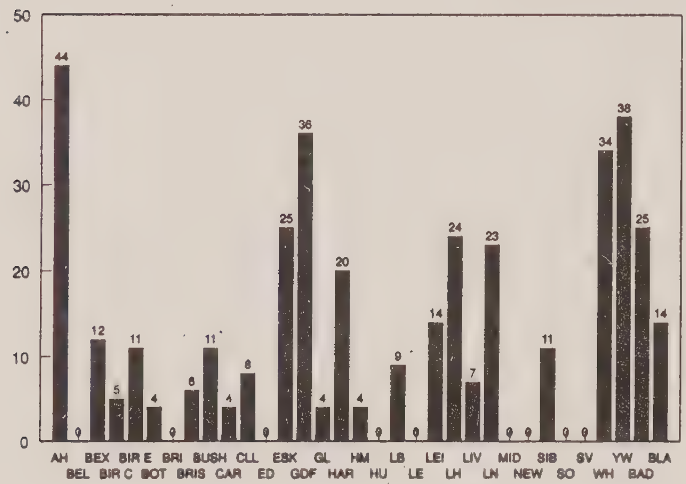


Figure 15: 8-hourly Ozone Concentrations Exceedances of 50 ppb (25-30 June 1995)

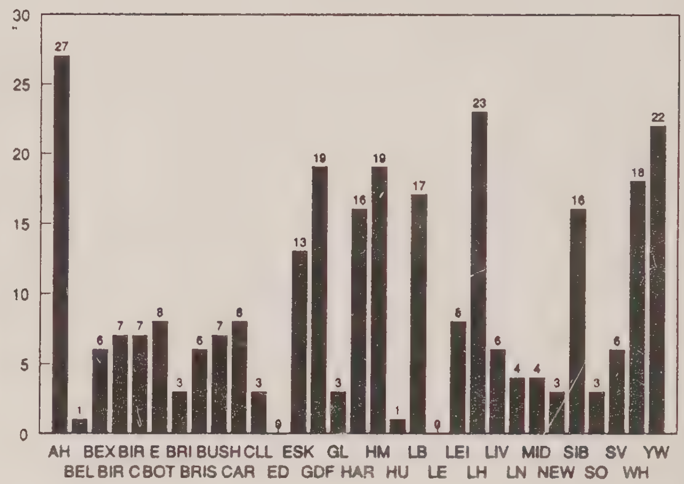


Figure 16: 8-hourly Ozone Concentrations Exceedances of WHO 50 ppb Guideline (April - June 1995)

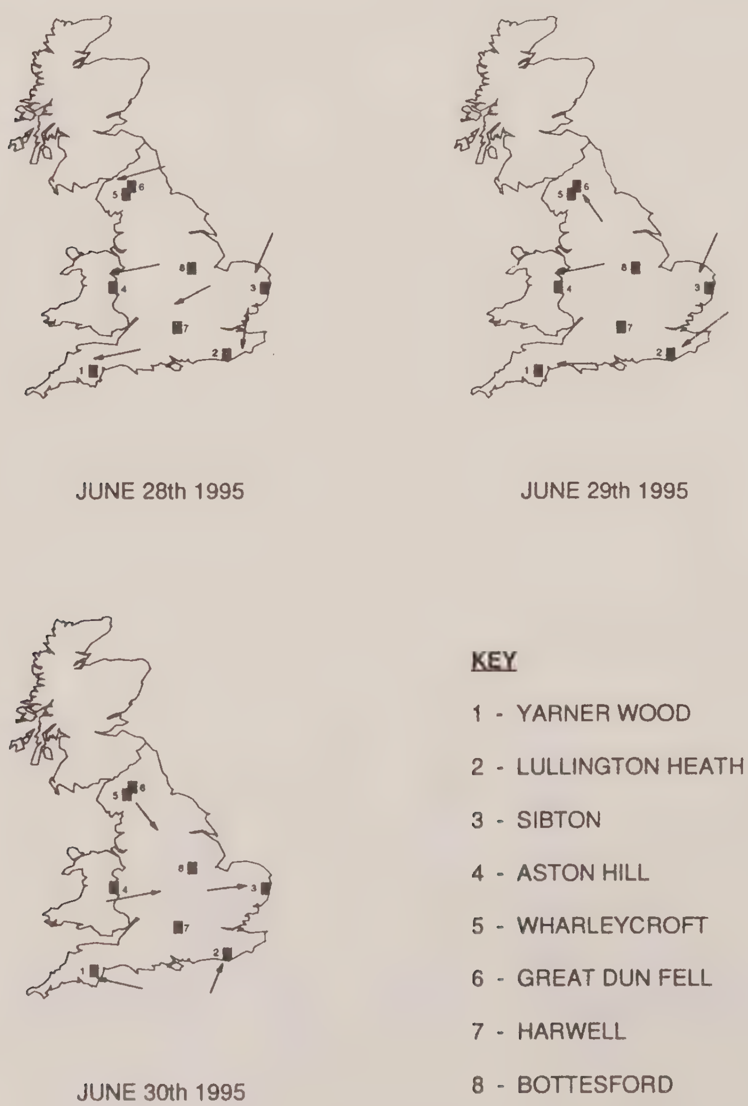


Figure 17: Locations of Eight Network Sites of Particular Interest

Figure 18: Location of Network Sites

Figure 19: Approximate Locations of Bristol Area Sites
1 = Bristol Centre AUN Site; 2 = Blaise Castle; 3 = Badminton

AIRCARE®

THE BRITISH COLUMBIA IN-USE VEHICLE EMISSIONS INSPECTION AND MAINTENANCE PROGRAMME

Steve Stewart
Motor Vehicles Emissions Inspection &
Maintenance Department
Province of British Columbia
Ministry of Transportation and Highways

The AirCare Programme was designed to address the problem of deteriorating air quality in the Lower Fraser Valley. With the population projected to double by the year 2021, studies predict that, if no action is taken, air quality in Vancouver could become as poor as Los Angeles is today. Light duty vehicles are collectively the largest source of emissions in the region. As one element in the overall air quality management strategy for the region, all passenger cars, motor homes and light trucks have, since September 1992, been required to pass or conditionally pass an emissions inspection prior to relicensing, regardless of age and use.

Vehicle Technology

Within the context of the development of vehicle emissions controls, vehicles in North America fall naturally into four groups, each using a different level or type of control technology. These groups can be briefly described as:

1 No emissions controls
2 Mixture controls and exhaust gas recirculation (EGR)
3 Oxidation catalysts and air pumps
4 Three-way catalysts with feedback mixture control.

In Canada it is particularly important to group vehicles by technology rather than simply using the model year because of the situation that existed particularly between 1981 and 1987. The US introduced more stringent emissions standards for new vehicles in 1981 which prompted the widespread adoption of three-way control for most US specification vehicles. Canada's new vehicle standards were not brought into line with the US until 1988, so most Canadian specification vehicles up to 1987 could achieve the required emissions levels without using three-way technology. Even so, there was still a sizable fraction of the Canadian fleet from these model years which did use the same technology as their US equivalents. So Canadian vehicles from 1981 to 1987 are mostly from technology group 3, but with sizable fractions from groups 2 and 4.

Inspection Procedures

AirCare was the first programme in North America to include a test for NOx as part of a dynamometer driving test. Inspection and maintenance programmes implemented prior to AirCare only tested vehicles for hydrocarbons and carbon monoxide. Since both HC and NOx are required to form ground level ozone, it was thought that reducing the amount of available HC would be sufficient to control ozone formation. However, newer theories suggest that effective ozone reductions can only be obtained by controlling both HC and NOx emissions.

Because NOx emissions are only produced in significant quantities when the vehicle is operated under load, a chassis dynamometer, which simulates driving, must be used to test vehicles. NOx emissions are inversely related to CO emissions; therefore, including a NOx measurement fails more vehicles than a conventional HC/CO-type idle inspection.

The field of vehicle emissions inspection and maintenance is undergoing considerable change in the United States at present, and the US Environmental Protection Agency (EPA) has developed an emissions short test called the IM 240; this is of 240 seconds duration and utilises a driving cycle very similar to the Federal Test Procedure (FTP). Since the aim of an inspection and maintenance programme is to identify vehicles that have emissions in excess of the certification standards, it is beneficial to check vehicles using a short test which correlates very well with the FTP. The IM 240 test procedure, with its transient driving cycle and constant volume sampling system, makes it possible to produce a result in grams per mile - the same units in which the Federal emission standards are expressed. Steady state tests, on the other hand, typically produce results in volumetric concentration units such as parts per million or percent. Due to the fact that steady state tests may represent only one or two operating modes on the FTP, it is difficult to establish an exact correlation factor. Therefore, steady state tests become less effective as the degree to which a vehicle exceeds the Federal standard becomes smaller.

The AirCare dynamometer test is steady state and uses an algorithm known as the ASM 2525 (Acceleration Simulation Mode, at 25mph and 25% of the maximum load that would be experienced in the FTP). NOx is measured during the dynamometer driving test, as well as hydrocarbons and carbon monoxide. Measurements of hydrocarbons and carbon monoxide are also taken at idle and, in the case of vehicles which fail the dynamometer test, at 2500 rpm. This provides the repair industry with a baseline for repairs. Emissions are measured by Non-Dispersive Infrared (NDIR) analysers controlled by the Emissions Measurement System (EMS) computer. Key data field are electronically transferred to the Programme Administration Office (PAO) computer system and through to the computer system at the Insurance Corporation of British Columbia (ICBC). (Further details of the inspection process are available from the Editor.)

At the moment, the AirCare test is highly effective in identifying excess emitters from the overall vehicle fleet in Vancouver. From the test records, it appears that about half of the fleet is from technology groups 1, 2 and 3. These vehicles tend to have easily identifiable defects which can be diagnosed and repaired by the service industry.

The emissions performance characteristics of new vehicles (technology group 4) are dramatically different to the older technology vehicles. As each new model year of newer technology vehicles displaces some of the older, higher-emitting fleet, the ability of the AirCare test to identify vehicles with marginally higher emissions than the Federal standards will diminish. It is likely that a recommendation to review adopting the IM 240 test procedure for newer vehicles will be made at some point in the next few years.

A particular strength of the AirCare programme is the automatic link with insurance and licence renewal, which ensures that every vehicle in the region is inspected each year. Despite the attractions of proposals to use remote sensing for on-road vehicle emissions, such technology can never test all the vehicles registered in the area. Any particularly gross emissions problems would usually have been already identified during the repairs following the regular AirCare inspection.

Maintenance

The benefit of any inspection and maintenance programme is only derived by requiring failing vehicles to be repaired. AirCare is one of the few motor vehicle emissions inspection and maintenance programmes in North America that requires a certified repair industry for emissions-related repairs. The AirCare certification process offers the most advanced consumer protection within the North American auto repair industry.

Vehicles that have failed the AirCare inspection are required to be repaired and reinspected prior to relicensing. If a vehicle cannot be brought into compliance with the required standard, a three-month licence can be obtained, providing adequate time for repairs. The vehicle cannot be relicensed and insured after the end of the three month period until it has passed or conditionally passed an inspection. A repair cost limit of between $200 and $400 permits vehicle owners to obtain a "conditional pass" if repairs up to the cost limit were performed at an AirCare certified repair centre.

Any person, including the vehicle owner, can perform repairs on a vehicle that has failed the emissions inspection, but only repairs performed by a certified technician at a certified repair centre are eligible for a conditional pass on retest. Eligibility for a conditional pass is established when the Repair Data Form (RDF) is completed and endorsed by the technician and the certified repair centre. The RDF is handed in to inspection centre personnel at the start of the retest procedure. The criteria for a conditional pass requires entry of repair information that is contained in the completed RDF. The conditional pass is issued at the completion of the inspection process. The data collected from the RDF provide the basis for performance monitoring of the certified technicians and repair centres. (Further details of the certification and performance monitoring of the repair industry can be obtained from NSCA.)

Effects of the Programme

The emissions characteristics of in-use vehicles are determined by two main factors:

- the emissions standard to which the vehicle was originally designed; and
- degradation of emissions performance due to in-use factors such as: failure to perform scheduled maintenance; improper adjustments by mechanics or do-it-yourselfers; deliberate removal of emissions control devices; failure of emissions control components due to age or mileage which go unrepaired because vehicle operation is not perceptibly affected; inability or unwillingness to make major mechanical repairs due to cost.

The first factor has been incorporated into the inspection standards so that no vehicle is expected to perform better than can reasonably be expected of that particular vehicle type and model year. The second factor is where the maintenance element of the programme is targeted. The following table, was derived by analysing RDFs from vehicles presented for reinspection.

Table 1. Most Common Repairs

Type of Fault	*Frequency*
Incorrect idle fuel mixture	65.8%
Incorrect idle speed	63.2%
Other carburettor/injector problems	55.8%
Incorrect spark timing	34.9%
EGR system defective	32.6%
Air filter dirty	30.7%
Spark plugs worn/faulty	22.5%
Catalytic concerter inoperative/missing	15.1%
PCV system defective	15.1%
Ignition wires defective	8.8%

Regular Constant Volume Sampling (CVS) testing is performed on a representative sample of vehicles after they fail the inspection and then again after they have been repaired. Overall, approximately 86% of repairs have been found to be effective in reducing emissions. This is accompanied by an overall fuel consumption improvement of approximately 7%. In almost all cases certified repairs are more effective than non-certified in reducing emissions, and also deliver the benefit of more fuel savings.

Table 2. Number of Effective Repairs

(upper number is all vehicles, lower number is repairs certified as having no remaining defects)
(effective repair = reduced one of the emissions which caused initial failure)

	HC		CO		NNOx		ALL	
TECH GR.	# fails	# eff. reps	# fails	# eff. reps	# fails	# eff. reps	# fails	# eff. reps
1	1	1 1	2	2 2	-	- -	3	3 3
2	3	2 1	10	7 2	2	1 1	13	9 3
3	16	14 9	40	38 31	13	12 5	64	60 42
4	14	12 9	32	26 20	11	8 7	44	35 27
All	34	29 20	84	73 55	26	21 13	124	107 75

Probable Future Developments

Inspection

As well as the possible future adoption of the IM 240 test procedure, at least for newer technology vehicles, another potential programme enhancement relates to the area of evaporative emissions from vehicles. EPA has determined that hydrocarbon emissions from evaporative sources like the fuel tank, fuel hoses, and carburetor float bowl are about equal to or even greater than tailpipe HC emissions. EPA has suggested that the charcoal canisters installed on almost all vehicles since the 1971 model year lose their effectiveness over time as a result of purge system failures. Also, any leaks which develop in the fuel system become significant evaporative hydrocarbon sources.

The EPA has devised a pressure/purge test which is designed to ensure that the fuel system is 1) not leaking and 2) that the purge function is taking place, thereby preventing saturation of the charcoal canister. The leak check consists of pressurising the fuel system using nitrogen gas and observing the rate of pressure decrease. The purge test consists of monitoring the flow of purge air in the purge line while the vehicle is operating on the IM 240 test. AirCare will likely add a pressure/purge test to the current procedure once the test equipment and procedure have been finalised and successfully field tested.

Another area for future devlopment concerns on-board diagnostic systems. More sophisticated on-board monitoring systems are being phased into the new vehicle fleet. By the 1996 model year, all vehicles will have to be equipped with systems that continuously monitor the function of important emission control devices. It may be possible, at some point in the future, to forego an actual tailpipe emissions analysis in favour of a software-driven diagnostic check which confirms the proper function of the vehicle's emission control system. Due to the length of time needed to achieve a majority of such vehicles in the fleet such a radical change in the test process would not be practical until sometime after the year 2000.

Maintenance

There is an increasing demand for skilled diagnosticians and service writers in the automotive repair industry. Discussions with certified technicians have revealed two specific areas of concern: a career path for certified technicians; and the lack of knowledgeable service writers who can interpret and explain emissions related problems when vehicles are brought in for repair.

The use of a Repair Cost Limit means that certified repair technicians must perform the least cost repairs to correct emissions system defects. This means that the technician is effective in diagnosing and identifying the root cause of the problem. The concept of having an effective diagnostician on staff may conflict with the practices of flat rate repairs because the flat rate allowances for emissions systems diagnostics are very low to non existent.

The PAO has developed an introductory course on the AirCare Programme for Service Writers and Advisors. This course deals exclusively with exhaust emissions and does not deal with such issues as writing a Repair Order or interpreting a customer's concerns to a technician who may not meet the customer. It is the PAO's contention that an effective

service writer or advisor can achieve a win-win-win situation: achieving the programme's objective of reducing exhaust emissions; addressing the customer's concerns; and performing effective repairs. The Provincial Apprenticeship Branch is now considering the feasibility of including Automotive Diagnostician and Automotive Service Writers programmes as apprenticeable occupations to be included in the automotive trades apprenticeship programme.

The development of training courses for an I/M programme should reflect the fleet composition of the programme area. While it is important for the technicians to be conversant with the new technologies being introduced into newer vehicles, it is equally important that the technicians are able to perform effective repairs on vehicles equipped with earlier levels of emissions control technology.

Implementation of repair centre and technician certification is an essential first step in monitoring the performance of the repair industry. Programme Administration officials must also develop a phased implementation of continuous improvement into the various systems being introduced to monitor the industry. This phased implementation minimises the risks of information overload and ensures a smooth transition.

Bibliography

1. GVRD Air Quality Management Plan, Summary Document, February 1994.

2. British Columbia Motor Vehicle Act Regulations, Division (40), 1992.

3. Milestones in Auto Emissions Control. US EPA Fact Sheet OMS-12, August 1994.

4. Title 40 Part 86 of US Code of Federal Regulations.

5. PAO internal memorandum 24 May 1995.

6. Radian Corporation Audit Report on the Effectiveness of the AirCare Programme, 1994.

7. British Columbia Vehicle Emissions Inspection and Maintenance Programme: Effectiveness of Repairs, SAE 950482.

8. British Columbia Vehicle Emissions Inspection and Maintenance Programme: Certification of the Repair Industry, SAE 950483.

UPDATE

ENVIRONMENT ACT 1995

The *Environment Act 1995* received the Royal Assent on 19 July 1995. A Commencement Order bringing the Agency into existence was made a week later; further Commencement Orders will be needed to bring the rest of the Act into force. Also significant parts of the Act are to be the subject of Regulations and Guidance from the Secretary of State. The Act covers the following areas of particular interest to *Clean Air* readers:

- **Environment Agency** (and, in Welsh, **Asiantaeth yr Amgylchedd**) will formally start its work on 1 April 1996. The Agency will take over the functions of HMIP, NRA, waste regulation authorities and the London Waste Regulation Authority. Ed Gallagher, formerly Chief Executive of the NRA, has been appointed Chief Executive of the Agency. The Agency's regional boundaries for water management purposes are based on river catchments and follow the existing eight NRA regions; regional boundaries for pollution prevention and control (and the public face of the Agency) will be based on the water catchment regions modified to fit County or District boundaries. The pollution prevention and control boundary for Wales will however be the boundaries of the Principality.
- **Scottish Environment Protection Agency** (SEPA) will also formally begin its work on 1 April 1996. SEPA will take over the functions of HMIPI, the river purification authorities, waste regulation authorities; it will also take over responsibility for the control of air pollution from Part B processes. Professor William Turmeau has been appointed Chairman of SEPA.

A principal aim of both Agencies in discharging their functions is to make a contribution towards attaining the objective of sustainable development. Ministerial guidance in this respect and in respect of their other objectives is to be issued.

- **Air Quality Management**: The Act requires the Secretary of State too prepare a National Air Quality Strategy for the UK. This will include

  - a framework of air quality standards and objectives for a range of pollutants.

  - a timetable for achieving the new objectives;

  - the steps the Government is taking and the measures it expects others to take to ensure the objectives are met;

District and unitary authorities will be under a duty to review air quality in their area and identify areas where air quality standards are likely to be breached. These areas will be designated air quality management areas (AQMAs). For each AQMA the local authority concerned will draw up an action plan to show how

it will meet air quality standards in future. There are wide regulation-making powers to provide for any new tools which local authorities might need; these could include regulations to enable local authorities to undertake vehicle emission checks and to levy spot fines on offenders.

- **Statutory Nuisance (Scotland)**: Part III of the *Environmental Protection Act 1990* has been amended to extend its provisions to Scotland. Sections 16-26 of the *Public Health (Scotland) Act 1897* are repealed.
- **Contaminated Land**: The Act adds Part IIA to the EPA 1990. Local authorities will have a duty to inspect their land to identify whether any is contaminated and whether any such land should be designated as a "special site" (to be defined in Regulations) because of the nature of the contamination. A detailed consultation process with all those with an interest in the land and the relevant Agency precedes the issuing of a Remediation Notice specifying what needs to be done to the land on a "suitable for use" basis. In some instances, instead of issuing a Remediation Notice, a Remediation Statement or Declaration (to be put on the public register) will say what is, has or will be done to clean up the land.

Part IIA of the EPA 1990 also deals with pollution from abandoned mines.

- **National Waste Strategy**: Section 92 of the *Environment Act* adds sections 44A and 44B to the EPA 1990 requiring, respectively, the Secretary of State as regards England and Wales, and SEPA as regards Scotland, to prepare a National Waste Strategy.

This should include policies for

- ensuring that waste is recovered or disposed of without endangering human health or using processes or methods which could harm the environment (including causing noise or odour nuisance).

- establishing an integrated and adequate network of waste disposal installations taking account of BATNEEC;

- encouraging the prevention or reduction of waste;

- encouraging recovery, reuse, reclamation, recycling etc and the use of waste as a source of energy.

Full details of those parts of the *Environment Act 1995* affecting the control of pollution and the consequential amendments to a number of other Acts including the *Environmental Protection Act 1990* and *Control of Pollution Act 1974* will appear in the 1996 edition of NSCA's *Pollution Handbook.* This will be published in February 1996.

APPOINTMENTS TO ENVIRONMENT AGENCY

Lord De Ramsey, formerly Chairman of the Environment Agency Advisory Committee, has been appointed Chairman of the new Agency. As mentioned above Ed Gallagher has been appointed Chief Executive. Other senior appointments include:

- Dr. David Slater (formerly Director and Chief Executive of HMIP) - Director of Pollution Prevention and Control;
- Jan Pentreath (formerly Chief Scientist and Director of Water Quality, NRA) - Director of Environmental Strategy;

- Giles Mance (formerly Director of Market Testing, NRA) - Director of Water Management;
- Nigel Reader (formerly Director of Finance, NRA) - Director of Finance;
- Archie Robertson (formerly Head of Distribution for the European Division of BP) - Director of Operations;
- Giles Duncan (formerly Director of Human Resources with South Thames Regional Health Authority) - Director of Personnel.

ATMOSPHERIC DISPERSION MODELLING

The Royal Meteorological Society has recently published, in collaboration with the Department of Environment a policy statement on Atmospheric Dispersion Modelling - Guidelines on the Justification of Choice and Use of Models, and the Communication of Results. The Executive Summary is reproduced below (by permission of the Royal Meteorological Society); full copies of the statement are available from the RMO at 104 Oxford Road, Reading RG1 7LJ; Fax: 01734 568571.

Executive Summary

These guidelines seek to promote the use of *best practice* in the use of mathematical models of atmospheric dispersion, emphasising the principle of *fitness for purpose* in the selection of modelling procedures, and the importance of effective communication in the documentation of reported results. The underlying objectives are to ensure the efficient use of resources, especially in the context of assessments conducted for purposes of demonstrating compliance with regulatory obligations.

The guidelines comprise considerations organised under the following ten headings:

1. *Statement of context and objectives* - to explain the situation being modelled and the purpose of the dispersion calculations, giving a clear account of the relationship between the objectives and the modelling procedures adopted to achieve them;

2. *Justification of choice of modelling procedure* - to demonstrate the *fitness for purpose* of the modelling procedure;

3. *Use of software implementations of modelling procedures* - to provide a fully documented account of the details of the model and its conversion into valid software;

4. *Input data* - to show how the data requirements of the model have been met, and to explore the implications on the assessment in cases where there are deficiencies in the available data;

5. *Presentation of results and conclusions* - to ensure the findings of the exercise are successfully communicated;

6. *Explicit quantification* - to ensure that best use is made of the opportunity to express results in quantitative terms;

7. *Sensitivity analysis* - to expose how the results depend on choices and assumptions made in respect of variables whose values may be debatable;

8. *Uncertainty and variability* - to ensure that these issues are addressed in respect of uncertainties in model parameters, the inherent variability of dispersion behaviour, and variations that are likely to be displayed between the results of one model and another;

9. *Quality assurance of models* - to demonstrate that the model used has been

subjected to an evaluation procedure establishing its suitability for a specified range of tasks;

10. *Auditability* - to ensure that there is a clear and transparent account of the exercise for inspection by interested parties.

The assessment of environmental impacts of discharges to the atmosphere is a topic of importance to a wide range of individuals and organisations. The guidelines are accordingly addressed to such interested parties, including operators of industrial processes, environmental consultants, researchers in the academic institutions and national research bodies, commercial software houses, public interest groups, regulators, and enforcing authorities. The issues raised also have a wider application in other scientifically-based fields where technical advice is sought and used in support of practical decision-making.

BENZENE EXPOSURE AND LEUKAEMIA

A major study published by the Institute of Petroleum in September has found no link between low-level benzene exposure and any type of leukaemia.

The study which took 2½ years to complete is the third in a series of epidemiological studies sponsored over the last 16 years by the Institute of Petroleum (IP). The study covered 23,000 oil distribution employees who had worked in the industry for at least one year between 1950 and 1975 and were based at 750 UK distribution centres run by BP, Esso, Fina and Shell. Amongst these employees, 90 leukaemia cases had occurred.

The study, carried out by Dr. Lesley Rushton, Senior Lecturer in Medical Statistics at the University of Nottingham, says: "there is no significant increase in the overall risk of all leukaemias, with cumulative exposure to benzene, or with intensity of exposure". The study covered lymphatic leukaemias (of the lymph system) and myeloid leukaemias (of the blood cells); it confirmed earlier studies which indicated that chronic and acute lymphatic leukaemias are not related to benzene exposure, and found no statistically significant increase of risk for acute myeloid leukaemia, the illness associated in prior studies with high levels of benzene exposure.

Note: See also *Atmospheric Benzene Concentrations near Petrol Service Stations in Middlesbrough*, which appears in the Report section of this issue of *Clean Air*.

REVISED PART B PROCESS GUIDANCE NOTES

The first 11 revised guidance notes on standards of air pollution control for industrial processes regulated by local authorities have now been published; all the PG notes originally published in 1991 and 1992 are due for review. The changes made to the original notes are generally by way of detailed, technical alterations but the review also aims to ensure that guidance is up-to-date, relevant, clear and imposes no greater burden on industry than is necessary to ensure an appropriate level of air pollution control.

The revised notes, all available from HMSO are:

- PG1/3(95) - boilers and furnaces, 20-50MW net rated thermal input, £4.50.
- PG1/4(95) - gas turbines, 20-50MW net rated thermal input, £4.50.
- PG1/3(95) - blending, packing,

loading and use of bulk cement, £4.40.

- PG3/3(95) - glass (excluding lead glass) manufacturing processes, £4.50.
- PG3/4(95) - lead glass, lead frit and enamel frit manufacturing processes, £4.50.
- PG3/6(95) - processes for the polishing or etching of glass or glass products using hydrofluoric acid, £4.00.
- PG5/1(95) - clinical waste incineration processes under 1 tonne an hour, £6.25.
- PG5/2(95) - crematoria, £5.75.
- PG5/3(95) - animal remains incineration processes under 1 tonne an hour, £5.25.
- PG5/4(95) - general waste incineration processes under 1 tonne an hour, £5.25.
- PG6/4(95) - processes for the manufacture of particleboard and fibreboard, £4.50.

TECHNICAL GUIDANCE NOTES

HMIP has recently published two more technical guidance notes in the monitoring series:

TGN M3 *Standards for IPC Monitoring Part 1: standards organisations and the measurement infrastructure* (£11.00) identifies the key standards-making organisations and discusses their interaction. The working procedures, motives for standards-making and the policies driving these organisations are also discussed.

TGN M4 *Standards for IPC Monitoring Part 2: standards in support of IPC monitoring* (£11.00) aims to identify British standards and standards from other relevant committees which may be suitable for monitoring prescribed substances in releases to air, water and land. Where appropriate, draft standards are also listed. Standards for sampling, analysis and testing of releases have an important role to play in ensuring credible measurements are made.

Although these TG notes particularly relate to monitoring of IPC processes, they may also be of relevance to the monitoring of Part B processes. TG notes are available from HMSO.

HM INSPECTORATE OF POLLUTION

Following David Slater's move to the Environment Agency, Dr. Allan Duncan has been appointed Chief Executive and Chief Inspector of HMIP.

HMIP's latest quarterly report (covering 1 April - 30 June 1995) reports that 1727 IPC authorisations have now been granted. HMIP made over 2000 visits to IPC sites during the quarter of which 62% related to routine compliance monitoring.

LANDFILL TAX

Earlier this year, HM Customs and Excise (together with other Government departments) asked for views on how the landfill tax announced in the 1994 Budget should be levied (see *Clean Air*, summer 1995).

In line with the majority of replies to the consultation paper, the Chancellor has announced that the landfill tax will be weight based, charged per tonne of waste; inert waste will be subject to a reduced rate of tax. Tax rates will be announced in the November 1995 Budget and the tax introduced on 1

October 1996.

New environmental trusts to clean up old landfill sites and promote sustainable waste management practices are also to be established. These will be largely funded by landfill site operators who will receive a rebate of 90% of their contributions, up to a maximum of 20% of their landfill payments.

AIR QUALITY DIRECTIVE

In June EC Environment Ministers reached a common position on a draft Framework Directive on Ambient Air Quality Assessment and Management. The Directive and the UK's national air quality strategy and local action leading from it are complementary.

The Directive sets up a strategic framework to reduce air pollution across Europe. It will be followed by Directives for 13 individual pollutants which will set numerical goals for the standards that the Directive establishes. The first of these, for sulphur dioxide, nitrogen dioxide, fine particles, suspended particle materials and lead, will be produced by the end of 1996.

The Framework Directive will set mandatory limit values for pollutants which Member States will have to attain within a specified time-period. It will also set alert thresholds at levels where short-term exposure to pollutant levels might pose a threat to human health. The Directive also contains guidelines for minimum levels of pollutant monitoring.

SULPHUR DIOXIDE AQS

An air quality standard for sulphur dioxide in the UK of 100 ppb, measured over a 15-minute averaging period has been recommended by the Government's independent Expert Panel on Air Quality Standards. This is the fifth report from EPAQS and its recommendation is based upon an assessment of available health and air quality data.

The Government is considering the implications of the EPAQS recommendation and is expected to include targets for sulphur dioxide in the draft National Air Quality Strategy which is currently being prepared. Targets taking accounts of the earlier EPAQS recommendations for benzene, ozone, 1,3 butadiene and carbon monoxide (all published in 1994) are also likely to be included in the Strategy.

EPAQS are expected to publish their recommendations for particles and nitrogen dioxide before the end of 1995.

BOOKS AND REPORTS

GENERATION IN THE 1990s: ELECTRICITY CAPACITY AND NEW POWER PROJECTS

M. Aveline et al, Oxford Economic Research Associates, 1995. £265.00. ISBN 1873482264

Once again OXERA have produced a detailed analysis of the performance of electricity generators and the outlook for future generation on a plant by plant basis. If planned projects go ahead, up to 10 GW of coal and oil fired power stations could be forced to close in the next five years. This would mean a major switch in fuel use, with coal consumption halving after 1998, while gas used in generation could rise to up to a third of total UK gas consumption by the year 2000. While this would be bad news for the coal industry, it would be good news for the environment, reducing emissions of SO2, CO2 and NOx. The document is essential reading for anyone interested in this key aspect of air quality and greenhouse gas emission management in the UK.

POLLUTION IN THE UK

D. Franklin et al, Sweet and Maxwell, 1995. £42.00. ISBN 0421456906

The book intends to give a practical analysis of pollution control for those in industry, commerce, government and private practice. It seeks to set out central principles and trends as well as current law (law stated is at September 1 1994, with only passing reference to the Environment Bill). Part One gives an overview of issues and trends, while Part Two covers UK and EC legislation.

AIRBORNE PARTICULATE MATTER

T. Kouimtzis et al, Springer Verlag, 1995. DM 198.00. ISBN 3540589325

One of a series of handbooks on environmental chemistry, this volume covers many aspects of particulate pollution - emissions, formation, physical, chemical and optical properties, sampling and analysis. It is aimed at undergraduates/postgraduates.

BLUEPRINT 4

Capturing global environmental value

D. Pearce, Earthscan, 1995. £10.95. ISBN 1853831840

Continuing the themes of the Blueprint series of using market forces in environmental protection, the possibilities of global bargains are examined. Pearce argues that only if everyone is given a self interested incentive to improve the environment will necessary action be undertaken. It looks at the effect of trade, population and over consumption on the

environment and the effects of population growth, poverty and overconsumption. He then shows how environmental value can be captured and describes the means for doing so.

ENVIRONMENTAL LAW
Meeting UK and EC Requirements

A. Mumma, McGraw-Hill, 1995. £24.95. ISBN 0077079523

Written from a practitioner's point of view, this book is aimed at non specialist lawyers and others who require an introduction to the subject. It looks at the regulatory framework in a national and international context. Chapters include water, land, waste, air, noise, assessment and auditing and environmental information.

BS 7750 IMPLEMENTATION WORKBOOK

Lloyds Register, 1995. £150 + £7.50 p&p

Aimed particularly at small and medium sized companies, this workbook takes a step by step approach to implementing an environmental management system. Clearly laid out and divided into 18 sections, it follows through preparation, policy and objectives, implementation and management. Assuming no previous management experience it contains exercises, examples and checklists.

REDUCING THE NEED TO TRAVEL:
some thoughts on PPG 13

J.H. Earp et al, Oxford Brookes University, 1995. £5.00 + £1.00 p&p.

Four papers by planners examining PPG 13, its implications and chances of success in reducing the demand for transport in the UK.

INTEGRATED POLLUTION MANAGEMENT
Improving Environmental Performance

F. Feates, R. Barratt, McGraw-Hill, 1995. £26.95. ISBN 0077078675.

Written for managers who want to know more about the principles of environmental performance of their activities and plant. It endeavours to avoid jargon and provide an accessible guide for the non scientist. Chapters cover concepts, understanding environmental performance, assessment, monitoring and communications, and each concludes with some practical points for action.

A SUSTAINABLE WORLD

T.C. Trzyna, Earthscan, 1995. £14.95. ISBN 1853832677.

This book is designed to clarify the issues and remove some of the ambiguity surrounding the concepts of sustainability and sustainable development. The contributors represent diverse backgrounds and perspectives. The contributions are divided into three sections looking at the concept of sustainability, measuring progress and indicators.

VITAL SIGNS 1995, 1996

L. Brown et al, Worldwatch Institute, 1995. £12.95. ISBN 1853832766.

This annual report on the current state of the world brings together indicators to environmental, economic and social well being. Atmospheric trends covered include rise in global temperature and resumption in the rise in carbon emissions. Other areas covered are economic, social, food, transport and military.

PRESCRIPTION FOR CHANGE

Health and the Environment

Friends of the Earth, 1995. £5.95. ISBN 1857502420

A research report that sets out to demonstrate how environment and health are linked, and environmental improvement will lead to improved health.

ENVIRONMENTAL LAW

R. Burnett-Hall, Butterworths, 1995. £125.00. ISBN 0421470909

A comprehensive practioners guide to the law including planning, conservation, chemicals and criminal and civil liability. Current to February 1995, a supplement is planned for summer 1996 to cover the Environment Act.

FUTURE EVENTS

6 NOVEMBER - Environmental Economic Instruments

Fifth in a series of conferences o the evolving state of environmental economic instruments; this conference will focus on the scope for environmental taxation as a strategy for national economic policy and on the landfill tax and its consequences for industry.
Venue: Royal Lancaster Hotel, London W2.
Details: Sally Bate or Amanda Jones, IBC Technical Services, Tel: 0171 637 4383.

13-14 NOVEMBER - Smart Cards in Transport: the Next Steps

Experience both in developing card technology and implementing transport applications will be reviewed.
Venue: The Merchant Centre, London.
Details: Carly Williams, International Conference Group, Fax: 01823 44 44 43.

14 NOVEMBER - Asthma: Confronting the Myths

The *South East* Institute of Public Health and NSCA's South East Division are holding this conference to provide factual information about asthma, what it is, prevalence and treatment; to consider the respiratory response to environmental allergens; and present a public health perspective.
Venue: Governor's Hall, St. Thomas' Hospital, London SE1.
Details: South East Institute of Public Health, Tel: 01892 515153.

15 NOVEMBER - Indoor Air: Understanding and Modelling Contaminant Transport

Indoor air pollution is commonly perceived to be a particular concern in naturally-ventilated buildings, where only limited control can be exerted over the ingress and inter-zone transport of contaminants. This workshop organised by the Aerosol Society, in collaboration with BRE and the Building Environmental Performance Analysis Club, will discuss the state of the art of design tools and guidance to further the development of strategies for controlling the ingress and transport of indoor air pollution.
Venue: Birkbeck College, London WC1.
Details: The Aerosol Society, Tel: 01275 843357.

15-17 NOVEMBER & 7-9 FEBRUARY 1996 - Environmental Mediation and Facilitation: The Essential Course

This full board residential sandwich course, run by The Environment Council, will help participants to understand and develop skills in consensus building.
Venue: Harborne Hall (The VSO Training Centre), Old Church Road, Harborne, Birmingham.
Details: Hally Ingram/Alex Bonner, The Environment Council, Tel: 0171 824 8411.

3-5 DECEMBER - Combustion and Emissions Control

The technical implications and solutions needed to meet the ever more stringent requirements of combustion and emissions control lead to the rapid adoption of new developments and research. This second international conference will provide a forum for discussing state of the art technology and experience, as well as exploring innovative research leading to new developments. This conference is organised by the Institute of Energy with a wide range of national and international co-sponsors including NSCA.
Venue: Commonwealth Conference Centre, Kensington High Street, London W8 6NQ.
Details: Mrs Judith Mackenzie, Institute of Energy, Tel: 0171 580 0008.

CALL FOR PAPERS

INTER-NOISE 96, LIVERPOOL, UK: 30 July - 2 August 1996

Noise - the next 25 years: scientists, engineers and legislators in partnership. Organised by the Institute of Acoustics and sponsored by the International Institute of Noise Control Engineering, this conference will include all aspects of the legislative and technical assessment and control of noise. for copy of form on which abstracts should be submitted (200 word max by 1 December) contact Miss Nicole Porter, Technical Programme Manager; Fax: 0181 943 6217. Email internoise96@newton.npl.co.uk.

Forthcoming NSCA Events

Tuesday 12 December 1995
NSCA Training Seminar
Health and Air Quality Management
- meeting standards, making links
National Exhibition Centre, Birmingham

Wednesday 31 January 1996
NSCA Training Seminar
Particulate Air Pollution
National Exhibition Centre, Birmingham
This is a joint venture with Middlesex University

Thursday 15 February 1996
NSCA Training Seminar
Noise Nuisance Update
National Exhibition Centre, Birmingham

Wednesday 26 & Thursday 27 March 1996
NSCA Spring Workshop
Air Quality Management
Abingdon

Tuesday 18 June 1996
NSCA Training Seminar
National Exhibition Centre, Birmingham

Monday 21 to Thursday 24 October 1996
Environmental Protection 1996
63rd Conference and Exhibition
Brighton

nsca

CLEAN AIR

AND ENVIRONMENTAL PROTECTION

WINTER 1995

Volume 25 Number Four

NATIONAL SOCIETY FOR CLEAN AIR AND ENVIRONMENTAL PROTECTION

WINTER 1995
VOLUME 25
ISSN 0300-5734

CLEAN AIR

CONTENTS

Publishing Director:
Dr. Tom Crossett
Secretary General, NSCA

Editor:
Loveday Murley

Communications Officer:
Tim Brown

Advertising:
Sally May
Rates on request.

CLEAN AIR is the official journal of the Society but the views expressed in contributed articles are not necessarily endorsed by the Society.

CLEAN AIR is issued free to Members and Representatives of Members.

CLEAN AIR Subscription for
1995 – £24.00
1996 – £25.00

CLEAN AIR is printed and published in England by the National Society for Clean Air and Environmental Protection, 136 North Street
Brighton BN1 1RG
Tel: 01273 326313
Fax: 01273 735802
Email: cleanair@mistral. co. uk

EDITORIAL

SOUND STANDARDS FOR NOISE POLICY

We have often described noise as the Cinderella issue in environmental protection. For a significant proportion of the population, noise pollution is an immediate and pressing environmental problem which impacts directly on health and quality of life. Yet until recently it has been low on the list of political priorities. Five years ago the Batho Report reviewed noise legislation and made a number of recommendations, many of which have been translated into legislation, regulation or future commitments. Yet the UK still lacks an identifiable noise control policy with targets and a strategy for attaining them. It is thus difficult to set priorities or gauge progress.

Air quality management is becoming quantitative. A similar approach could be adopted for noise. Clear and realistic goals would also make it possible to gain support for measures which otherwise might be unacceptable or controversial. But there are difficulties. The effects of noise are often difficult to assess. If there was agreement on effects, what targets would be appropriate? And how would improvements be measured? As ever, action in the UK is likely to be prompted by Europe. The European Commission is showing interest in developing a framework Directive on noise which may adopt an assessment and management approach similar to the new air quality framework Directive. We will learn more of the Commission's intentions at the NSCA Noise Update Seminar in February.

In the UK the inexorable rise in neighbour noise complaints and associated public disquiet has led to a welcome increase in political concern. On the basis that "something must be done", a DOE-supported Private Member's Bill will soon see the light of day and give force to recent proposals for a new night-time noise offence. Whether the creation of a new offence will make local authorities more effective in dealing with noise complaints remains to be seen. The number of authorities adopting and using the powers will ultimately provide the proof of the pudding. NSCA is undertaking a snap poll of local authority officers to gauge opinion on this point and the results will be reported at our seminar.

One thing is certain. If the Government wishes to address the noise control problem it could achieve rapid results by setting clearer objectives for local authorities and police. Much could be done to improve enforcement of the existing legislation. Discussions about the Noise Bill should not divert attention from the fact that noise enforcement is a resource-intensive activity, whether for local authorities or the police. NSCA welcomes improvements in legislation, but legislation cannot be effective without adequate resources for enforcement.

the time scales are long. I was working at St Thomas's Hospital in the early 1950s when we had the great smog; I well remember the wards which were full of older people with acute respiratory disease, many of them on respirators. The infants too suffered. On admission it was necessary to wash the black material from their stomachs, otherwise they collapsed and died from the toxic effects. While there have been tremendous improvements since then, we remain very concerned about the need to improve air quality – a concern shared by the public. At the beginning of August, I was sitting contemplating the beautiful icecap of East Greenland and as I looked around my immediate environment in the small habitation of Ammassalik, which calls itself a city but is really like a big village and the only one on the east coast, I sadly realised the truth that it is inherent in humans to pollute their environment no matter how few their numbers may be.

The growing interest in the environment must be fostered with vigour or the overall situation in the world has the potential to get worse as the population increases at an alarming rate. I am sure you are familiar with the way that the population has exploded in many parts of the world, especially during this century (Figure 1), and indeed continues to do so. There is little doubt in my mind that the vital components in the control of the population explosion are the education of women, improvement in their status and improvement in the survival of their infants and children; and we have seen that very much amongst the infant mortality in our own country where the changes have been dramatic and we no longer have the explosion of the population seen in Victorian times. This is illustrated by the dramatic fall in infant mortality in the United Kingdom as shown for England and Wales in Figure 2.

There is a consensus among the world's women, with the exception of sub-Saharan Africa, that they want fewer children (Craft, 1995). Now you may consider this a very strange way to commence a talk on the environment and health but the impact of the population explosion has the potential to be very harmful to the environment. In 1988, on 27 September, Mrs Thatcher said it all:

> "It is possible that we have unwittingly begun a massive experiment with the system of this planet itself."

In 1992 the Government published its far-sighted document *The Health of the Nation. A Strategy for Health in England*; similar documents were published in the other parts of the United Kingdom. This document referred to the quality of the environment having an important influence on health and it stated that the most urgent priority for research was to pinpoint more accurately this linkage. It was suggested there was a need for an Institute for the Environment and Health. This was subsequently established on the University of Leicester's campus and is a most welcome development.

There are however immense difficulties in linking some aspects of the environment with health and I am particularly thinking of chemical pollutants. In my talk today I am proposing to discuss some principles which we must consider when we are trying to establish whether there is indeed a linkage in a particular situation or with a single pollutant or with a mixture of pollutants. I am very aware that major environment decisions should not be taken without considering the economic and social aspects. Today, however, I am concerned with the medical and scientific aspects as they relate to health.

Correlation Does Not Necessarily Imply Causality

The first principle is that correlation must not be interpreted as necessarily implying causality: the role of confounding variables must be considered. I believe that this principle is the one that the lay public have most difficulty in understanding and accepting.

I am going to use an example from my own experience. In 1964 some colleagues and I (Moncrieff *et al*, 1964) suggested, I believe for the first time, that in children the levels of exposure to lead accepted at that time as safe might in fact be too high. In subsequent work, by numerous researchers worldwide, there is agreement that lead exposure can affect a child's IQ and neuropsychological development. Many actions have been taken in the United Kingdom and elsewhere to lower exposure, and I think in the UK we have done particularly well. I remember the first time I rang up Brussels about lead exposure in children and was told by a very senior official that it is a UK problem – "We don't have a lead problem on the continent!". Well of course time has shown that that was a myth. There does remain argument about the lowest exposure at which there is a real effect on the child. There is of course clear evidence of brain damage after severe exposure to lead, a situation which is now rare in the UK.

Exposure in children is usually assessed by measuring the concentration of lead in a blood sample or, less frequently, by measuring lead in shed teeth. If blood lead and IQ are measured in a child there may be a difference of up to seven IQ points between the lower and slightly higher exposures (see Figure 3). Such a simplistic approach fails to take account of confounding variables affecting lead and IQ. Confounders (Smith *et al*, 1983) that can actually affect the child's intake of lead include factors such as the cleanliness of the home, playing in the street, sucking fingers, eating meals with unwashed hands, actually eating dust from the road and whether the mother smokes (see Figure 3). Confounders affecting the IQ and development of the child include the IQ of the mother and many social and parental variables such as the availability of toys and books, whether the mother belongs to a public library and how much the mother and child share activities together. These are all important and it is misleading just to relate IQ to lead; it is essential to take into account these two groups of variables and I have only listed some of them (see Figures 3 and 4).

Actions taken in the UK over the past years have lowered children's intake of lead from a whole variety of routes. By 1988, in a review for the Medical Research Council, it was concluded from a survey of the literature that observed statistical associations were consistent with the hypothesis that very low level lead exposure had a small negative effect on the performance of children; but it was not possible to conclude that exposure to lead at the urban levels that were then current, were definitely harmful. In 1994, a group of experts (Pocock *et al*, 1994) published a systematic review of the epidemiological evidence from 26 studies that were carried out worldwide and considered to be of reasonable standard. It was concluded that the overall findings showed a small, but potentially important, deficit in full scale IQ among children with raised body burdens. It was however pointed out that the inherent limitations of observational epidemiology in pinpointing the reasons for this association meant that uncertainty still remained about the real effect on the child at these lower exposures.

Publication of *Environmental Health Criteria for Inorganic Lead* from the International Programme on Chemical Safety is expected shortly. The task force preparing it used much of the evidence that I have just been discussing and it is likely that it will state that there is not a threshold for lead, but that inherent difficulties in this sort of work make it impossible to reach a definite conclusion. I should point out that on the evidence which we have (personal communication from Dr H.T. Delves, Director of the Trace Element Laboratory at Southampton) levels of lead in the blood of children in England are generally lower than those in the 26 studies referred to above. The DOE has recently commissioned a formal study of blood leads in a cross-section of our children. At present our decision makers have a dilemma: should the exposure be reduced even further which perhaps is not necessary and would certainly be very costly, or is the finance better spent on items such as nursery schools, playgroups, or better education in parenting. We are still in a quandary about the significance of these very low levels even after 30 years of research.

Perhaps I could briefly turn to another example – asthma. In the economically developed world there is definitely an increase in the prevalence of children who have respiratory problems. This includes asthma which is more frequent in the offspring of first generation migrants from rural to urban environments, so it does appear that environmental effects of some kind are important in the etiology (Newman-Taylor, 1995). It also appears that other allergic diseases like urticaria and hay fever are more common too. There is most probably an overall increase in allergic disease caused by an immediate type of hyper-sensitivity reaction which appears in individuals carrying an hereditary disposition; if one parent has this sort of condition the chance of a child inheriting it is about 50% but if both parents have one of these conditions the figure rises to about 60% (Seaton *et al*, 1994).

Although asthmatic attacks can be precipitated by air pollution and by respiratory viral infections, that does not necessarily imply that these are the causes of the asthma. Even the role of air pollutants in precipitating attacks requires further study. Since giving this address the Committee on the Medical Effects of Air Pollutants (1995) has published its report on *Asthma and Outdoor Air Pollutants* and concluded that "the effect of (air pollution) if any, is generally small and the effect of air pollution appears to be relatively unimportant when compared with several other factors (e.g. infections and allergens) known to provoke asthma". This is a surprising finding and illustrates the complexity of the problem and the need for excellent scientific and medical research. It appears from the evidence so far that in infancy and in occupational workers who are newly exposed to allergens at their work that sensitisation to allergens is important in the etiology. Sensitisation might arise from indoor and outdoor air pollutants, from smoking during pregnancy, from an increase in house dust mites which presently enjoy a warm environment with central heating, carpeting, insulation and so on, from respiratory infections, from over protection of young children so that their immune systems do not develop properly because they are not exposed to infections in the same way, from small family size so that again children are not exposed to so many infections (Strachan, 1989; von Mutuis *et al*, 1994), or from dietary factors. There is evidence that a high sodium intake may be important since this element can affect the bronchial tract (Burney *et al*, 1986; 1989). The role of lower intakes of dietary anti-oxidants may be another very important factor in increasing susceptibility to infections and inflammation of the airways. Anti-oxidants are present in fruit and vegetables (Langseth, 1995).

It is easy to understand why the public correlates the cause of asthma with more traffic and air pollution from vehicles. At present however the cause of asthma is not at all clear. Although air pollution can precipitate asthmatic attacks or aggravate existing chronic asthma the effect of the chemicals which pollute air appears to be generally small. The role of biological allergens in air, e.g. pollen, remains unclear.

Decisions Must Be Based on Proper Scientific and Medical Evidence

This principle is absolutely essential: when decisions are being made they should be based on proper scientific and medical evidence which must be of the highest standards. It is, therefore, essential for original work to be examined very critically in relation to health and the environment; the correlation is extremely complex but it is a field in which there are many poor studies. For the benefit of lay members in the audience I would suggest that expert advice is sought on the quality and interpretation of original work. Publications generally which are not in peer reviewed journals should not really be used in the determination of policy. There will of course be publications which come out as separate volumes in their own right from respected research institutes or from government departments. Unfortunately very poor studies can be given as evidence by the public in relation to the NIMBY syndrome for example.

Individual Exposure Should Be Measured

My third principle is that attempts must be made to measure individual exposure in studies concerned with the effects of pollutants on health and disease, so far as this is possible. Sampling and measurements whether on people, air, soil, water, or food must be based on sound science (Coggon, 1995). There is a lack of reliable information on exposure to various pollutants since it is so very difficult to obtain. The route of exposure may be through ingestion, inhalation or skin contact. The amount of a pollutant actually reaching and interacting with a target organ in the body has to be taken into account in the interpretation of data.

I have taken a special interest in the sampling and measurement of chemical pollutants and I have been interested to observe that it is rare for environmental studies reported in the literature to comment on the precision and accuracy of the laboratory findings. That is a major deficit and should not be allowed to continue.

The precision of the measurements for some compounds can be poor even in the best of hands; for other compounds the precision and accuracy can be very good but it strikes me as extraordinary that in this day and age proper analytical data are not included in original papers. This was a problem in clinical biochemistry some years ago and I recall how many laboratories were not up to scratch. I believe that measurements should be made in accredited laboratories, all of which should participate in quality assessment schemes. I would commend as a model the Clinical Pathology Accreditation UK Limited scheme (1995). Although their handbook is for pathology laboratories it does contain a lot of sound sense and to my mind it shows the standards to which the environmental laboratories should be aspiring. Of course there are some excellent techniques and there are some very good laboratories but unfortunately there are poor standards too.

Diffuse Exposure and the Effects of Mixtures

My fourth principle is that the effects of low level diffuse exposure and the effects of mixtures seen with many chemicals, dioxins for example, are particularly ill-understood and these limitations should be recognised. Even in studies on air quality where the clinicians may be investigating patients with respiratory problems it can still be very difficult to elucidate the role of each pollutant and whether there is synergism between compounds.

With low level diffuse exposure, confounding variables can be particularly difficult to handle; for example, near a landfill or a factory there may be poverty, poor housing and unemployment, which can themselves contribute to poorer health. It is essential to assess and adjust for these sorts of confounders but once again this is something that the public find it very difficult to understand.

Performance and Interpretation of Studies by Experts

My fifth principle is closely linked to the fourth one and that is that performance and interpretation of epidemiological studies including those concerned with "clusters" should be performed by experts well versed in dealing with data on people. The Medical Research Council has a large Environmental Epidemiological Unit at Southampton in association with the University and there is a Small Area Health Statistics Unit, set up in 1987, at the London School of Hygiene and Tropical Medicine. The work of the latter is based on a comprehensive national database of cancer registrations and specific causes of death. The UK is fortunate that cases can be located by the postcode of the place where the person was living at the time of registration or death and the census data are also available. The public do get concerned when they see a "cluster" of a congenital abnormality in their neighbourhood. The Unit is in a unique position to determine whether this is a chance finding or really indicates an environmental problem.

Determining How a Pollutant Causes Harm

My sixth principle is that increasingly emphasis must be placed on determining the mechanism whereby a pollutant can cause harm. Toxicology can now put much greater emphasis on mechanisms following developments in biochemistry and particularly molecular biology. Animal experimentation has served us well; it still has a role but there are always the problems of species differences in response to a chemical and in the extrapolation of results to humans. For example there are about 200 known rodent carcinogens compared with about 60 that are known to affect humans.

The Relevance of Age in Both Exposure and Toxicology

My seventh principle is that it is necessary to take age into account when considering both exposure and toxicology (WHO, 1986). For example, my colleagues and I carried out a study on lead balances: that is measuring the uptake of lead from food and water and excretion in faeces and urine (Figure 5). Children were found to be absorbing 53% of the lead and retaining 18%, whereas adults over 70 years of age actually had negative absorption and no retention, probably because lead was being lost from the bones.

In the future genetic susceptibility will have to be taken into account. It is one explanation why different people react in different ways to exposure to a particular compound or environment. I see it as a growing field in epidemiology and one that is going to be very important. It does however raise serious ethical problems which society will have to address.

Best Practicable Environmental Option

My eighth principle is that a study based on the Best Practicable Environmental Option (BPEO) (Royal Commission on Environmental Pollution, 1988) should be used as much as possible when looking at pollution problems, as it enables social and economic factors to be taken into account when coming to conclusions. Far more emphasis should be placed on health in the BPEO process. The BPEO is a major factor in pollution control and it was developed in the 12th Report of the Royal Commission on Environmental Pollution while Lord Lewis was Chairman. The Commission, because of its remit, emphasised the environmental aspects but to my mind that would not exclude taking health effects into account during the selection of the BPEO and at every stage of the audit trail. I believe that the public would be less disturbed by NIMBY if the audit trail included health effects so far as they were known and were in a public document which included references to relevant reliable studies presented in a manner suitable for the lay person.

Understanding Risk

My ninth principle is that the public and the media certainly require a greater understanding of risk. Maybe the time to learn about this is at school as a part of mathematics. As a population we do have a strange perception of risk. We accept risks associated with, for example, smoking, motor bikes and cars, all of which lead to death in large numbers of people, and have been with us for a long time. We also seem to accept the fact that the major cause of death in childhood is accidents in our community. On the other hand as a population we are very concerned at present about asthma, maybe because it is a newer risk and is prominent in children – although we still accept accidents! We are also more concerned about rare conditions: a “cluster” of a congenital abnormality or a very small number of people who have developed a cancer after suspected exposure to radiation or a particular chemical pollutant. We know smoking is harmful but we see the risk perhaps as far away in the future and in any case smoking is under the control of the individual. The latter is not of course true for the foetus who may be harmed if the mother smokes nor is it true for passive smokers who have no control over the situation.

Scientific and Medical Evidence as a Basis for Setting Standards

My last principle is that when limits of exposure are set on political grounds – as I think they are sometimes – rather than on the best scientific and medical evidence then this should be acknowledged. I think that it is an important principle and I remain unconvinced that politics never enters into the setting of standards.

Conclusions

I hope that these ten principles may be a useful way of looking at health and the environment. It is a highly complex field – trying to relate pollution to health is very difficult. I cannot emphasise too much the need to base decisions on the highest standards of medical and scientific evidence which has been interpreted by people who understand it. That is not to say that the public should not be involved in decisions but it is unfortunate that they can be presented with emotive evidence which is based on poor medical and scientific work.

References

Burney, P, Britton, J.R, Chin, S, *et al*, 1986. Response to inhaled histamine and 24-hour sodium excretion, *Brit Med J*, **292**, 1483-86.

Burney, P, Nield, J.E, Twort, C.H.C, *et al*, 1989. The effect of changing dietary sodium on the bronchial response to histamine, *Thorax*, **44**, 36-41.

Clinical Pathology Accreditation (UK) Ltd., Version 6.2, created 01/02/95, obtainable from the Children's Hospital in Sheffield.

Coggon, D, 1995. Assessment of exposure to environmental pollutants, *Occup and Envir Med*, **52**, 562-564.

Committee on the Medical Effects of Air Pollutants, 1995. *Asthma and Outdoor Air Pollution*, HMSO, London.

Craft, N, Beijing and the future of women, 1995. *Brit Med J*, **311**, 580-581.

Langseth, L, 1995. *Oxidants, anti-oxidants and disease prevention*, Publ by International Life Sciences Institute Europe, Belgium.

Medical Research Council, 1988. The neuropsychological effects of lead in children. A review of the research. 1984-1988.

Moncrieff, A.A, Koumides, O.P, Clayton, B.E, Patrick, A.D, Renwick, A.G.C and Roberts, G.E, 1964. Lead poisoning in children, *Arch Dis Childh*, **39**, 1-13.

Newman-Taylor, A, 1995. Environmental determinants of asthma, *Lancet*, **345**, 296-298.

Pocock, S.J, Smith, M, Baghurst, P, 1994. Environmental lead and children's intelligence: a systematic review of the epidemiological evidence, *Brit Med J*, **309**, 1189-1197.

Royal Commission on Environmental Pollution, 1988. *Best Practicable Environmental Option*, Twelfth Report, Cmnd. 310, HMSO, London.

Seaton, A, Gooden, D.J, Brown, K, 1994. Increase in asthma: a more toxic environment or a more susceptible population, *Thorax*, **49**, 171-174.

Smith, M, Delves, T, Lansdown, R, Clayton, B and Graham, P, 1983. The effects of lead exposure on urban children: the Institute of Child Health/Southampton study, *Dev Med & Ch Neurol*, **25**, Supplement 47.

Strachan, D.P, 1989. Hay-fever, hygiene and household size, *Brit Med J*, **299**, 1259-1260.

The Health of the Nation. A Strategy for Health in England, July 1992. HMSO, London.

von Mutuis, E, Martinez, F.D, Fritsch, C, Nicolai, T, Reitmeir, P and Thiemann, H.H, 1994. Skin test reactivity and number of siblings, *Brit Med J*, **308**, 692-694.

WHO, 1986. Environmental Health Criteria 59. Principles for evaluating health risks from chemicals during infancy and early childhood: the need for a special approach.

Figure 1: World Population Growth with Future Projections (from NERC)

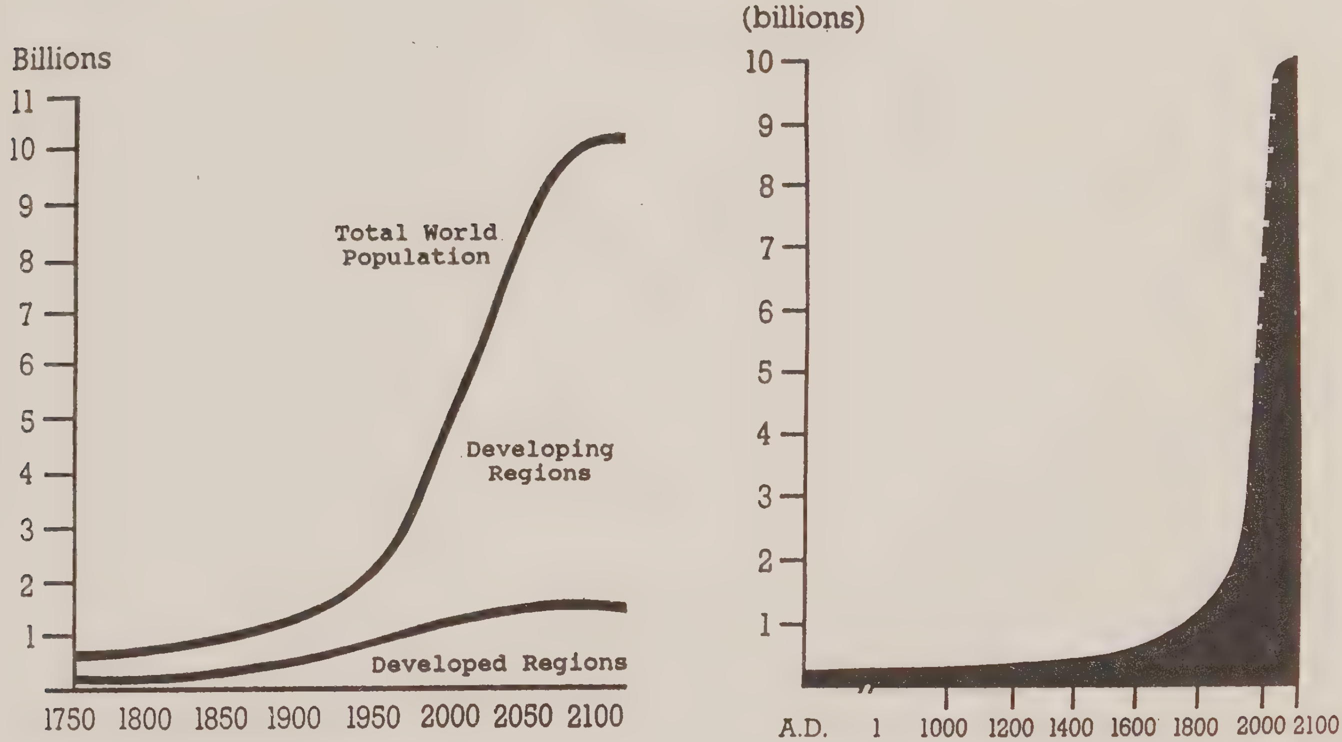


Figure 2: Infant Mortality (deaths in the first year of life) – England and Wales 1846-1991 *(source: OCPS)*

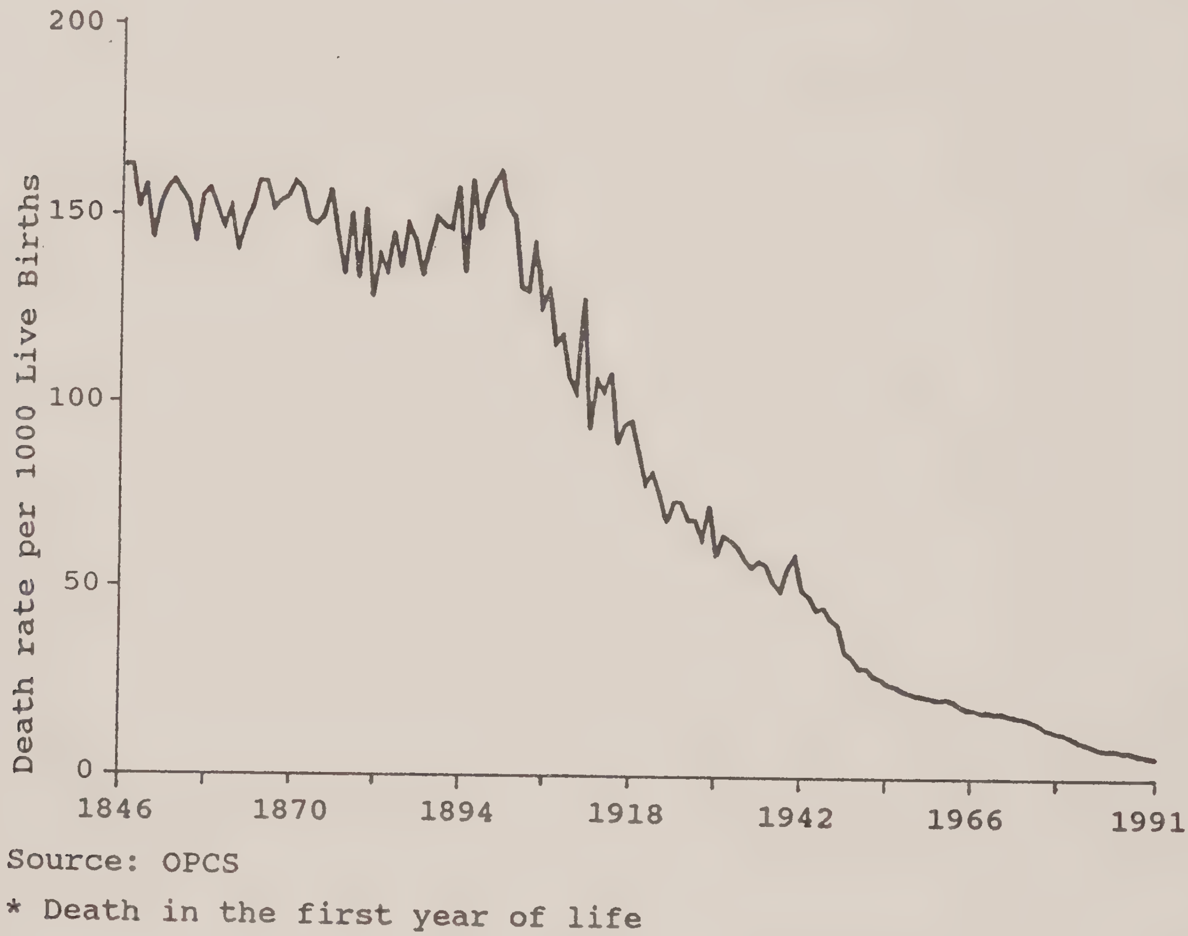


Figure 3: Lead and IQ

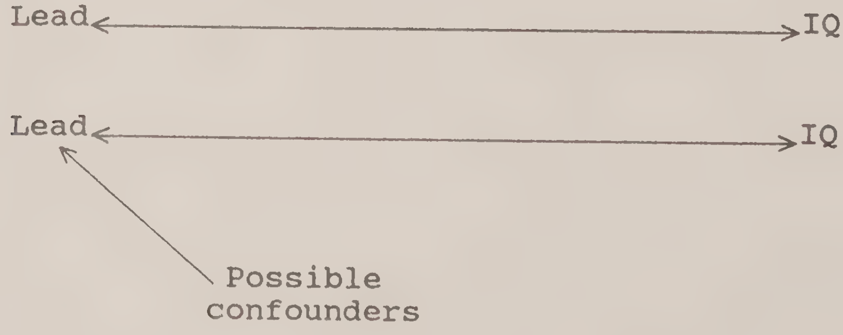
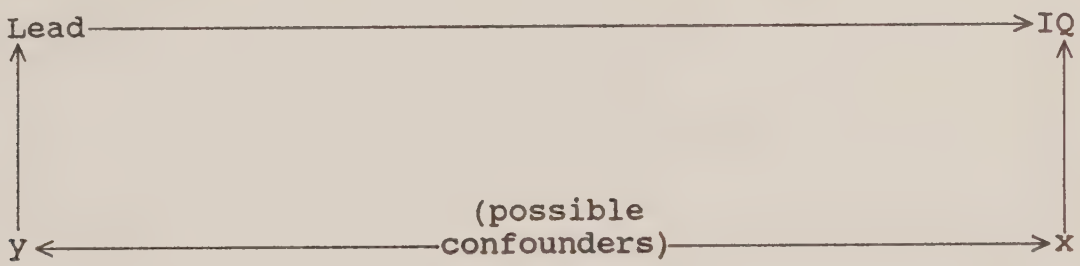


Figure 4: In order to Look at the Variance due to Lead



What contributes to child's lead uptake i.e. correlation between variables in the child's environment and his habits with his body burden

What variables contribute to child's performance in the tests of IQ, performance and behaviour

Figure 5: Lead Balances – Children v Adults over 70

Lead Balances

	Percent absorption	Percent retention
Children	53	18
Adults over 70 years	-5	-16

NEWS AND VIEWS

COUNCIL OF THE SOCIETY

At the meeting of the Council of the Society held on 23 October 1995 in Scarborough, Mr. George Barrett (PowerGen PLC) was elected Chairman of Council for the year 1995-96; Mr. Paul Cooney (Chairman of the SE Division) becomes first Deputy Chairman and Cllr. Jack Carr (Chairman, Yorkshire & Humberside Division) second Deputy Chairman.

Honorary Member of the Society

At the Annual General Meeting of the Society held on 23 October 1995, Mr. John Boddy was made an Honorary Member of the Society in recognition of his many years service both as a member of the Divisional Council of the South East Division and as one of their representatives on the Council of the Society. John Boddy has also served on the Council's Technical Committee for many years and was its Chairman for a number of years.

SECRETARY GENERAL TO CHAIR SOUTHERN REPAC

The Environment Secretary has appointed NSCA Secretary General, Tom Crossett, as Chairman of the Regional Environment Protection Advisory Committee for the South.

The *Environment Act 1995* (section 12) requires the Environment Agency to set up regional committees for the different regions of England and Wales. The Agency is required to consult the committees about proposals relating to the way in which it carries out its functions in the regions, and must also consider representations they make to it. The REPACs will provide a regional perspective on national policy, as well as consider matters of particular importance to individual regions.

DIVISIONAL NEWS

East Midlands and Eastern Divisions

Fifty-eight members and guests attended the final open meeting of 1995 for the Divisions at Hanson Brick, Kirton Brickworks near Ollerton, Nottinghamshire on 29 November. The meeting was hosted jointly by the Brick Company and Newark & Sherwood DC. The morning session involved a technical presentation by Ian Walker, Technical Manager, Hanson Brick Ltd who described how the Company had responded to current environmental pressures. He then explained the workings of the limestone fluoride scrubber and research into fluoride fixation in brick manufacture by the addition of fluxes and additives. Waste reduction and minimisation was a key theme of the talk and he said that the site at Kirton had now achieved less than 1% waste whilst producing two million bricks per week. This presentation was followed by a tour of the plant.

The afternoon session was devoted to a technical presentation by David Pickles, Chief Architect and Energy Manager, Newark & Sherwood DC. In his talk he concentrated on the initiatives being taken by the Council with regard to residential energy conservation using the slogan *"Save Energy = Save Money"*. He outlined the theory and principles behind the "Boughton Energy Village 2001" which was on target for achieving its aim of a 60% reduction in carbon dioxide emissions (based on 1988 figures) by the year 2001. Another initiative was the "Nottinghamshire Energy Club" which would look at improving energy efficiency in homes and therefore reduce energy costs. The target of the project was to meet affordable energy criteria for all householders through four goals: full house central heating; cost effective insulation and lighting improvements; controlled ventilation; and education, advice and guidance.

In thanking the speakers, Hanson Brick and Newark & Sherwood DC, the Divisions' Chairman noted the relevance of Newark & Sherwood's energy initiatives to the new *Home Energy Conservation Act 1995* and suggested that this was a topic that the Divisions would want to come back to in the not too distant future.

The Hon Secretary of the Division gave a presentation to the CBI's East Midlands Division on 20 October on Local Authority Implementation of the *Environmental Protection Act 1990* in which he highlighted both problems and successes. The opportunity was taken to promote better contact and encourage membership of the Society from East Midlands Industry.

Divisional Council meetings for 1996 have been arranged for 15 February, 6 June and 17 October. Seminars on "Discharges from Abandoned Mineworkings" and "Environmental Pollution and Health" are being arranged; the latter will be held jointly with Derby City Council and South Derbyshire Health Authority. Further details will be available from the Hon. Secretary. *(Dr. Bill Pearce, Hon. Secretary, East Midlands & Eastern Divisions, Tel: 01623 656656)*

North West Division

Manchester Airport hosted the 1995 AGM of the North West Division which was attended by 40 delegates. After the morning's business, Chairman of the Division, Roger Hebden, presented a plaque to Dr. John Allen, past Chairman, for eight years' service to the Society.

In the afternoon, Alan Melrose, Manager of Manchester Airport's Environmental Control, described the Airport's environmental policy, mentioning in particular the environmental commitments made at the recent public inquiry for a second runway. He was followed by Dr. David Raper (Atmospheric Research and Information Centre), who talked about air pollution monitoring and control at the Airport. *(Source: Planetalk, Nov. 1995)*

Scottish Division

The Scottish Division are starting 1996 with two seminars. The first took place on 15 January and looked at local air quality management.

The second is to take place on 20 February in conjunction with the Division's AGM (which will take place in the morning). The half-day afternoon seminar on the *Environment Act 1995* will have speakers on the establishment of SEPA, local air quality management, contaminated land and noise nuisance. Further details are available from Clare Carruthers, tel: 0141 227 5564.

South East Division

The Division in conjunction with the *South East* Institute of Public Health held a conference at the Governor's Hall, St. Thomas's Hospital London, on 14 November. "Asthma: Confronting the Myths" attracted 128 delegates which included medical practitioners, nurses, social workers, EHOs, councillors and students.

The aim of the conference was to provide factual information about asthma – its causes, prevalence and treatment and allergic responses and to apply a public health perspective for responding to asthma. The morning session was chaired by Melinda Letts, Chief Executive of the National Asthma Campaign, and the afternoon session by Professor I. Phillips, Clinical Dean UMDS St. Thomas's Hospital. Eight speakers, each an expert in their respective field covered all the contributing factors to this disease. The contributing list (see box) is quite extensive, taking into account genetic and environmental factors and illustrates the magnitude and complexity of the problem.

- allergies from dust and house mite droppings found in bedding and soft furniture;
- furry and feathery animals; cockroaches; foods, e.g dairy products, peanuts, soya bean dust, shellfish, alcohol; yeasts and mould spores; pollens from grass grains; trees – alder, birch and hazel; ragweed;
- medical conditions like viruses; changes in hormone levels in women; attacks triggered after taking aspirin; changing weather conditions, e.g breathing in large quantities of cold air after exercise or laughter; undue stress;
- occupational asthma from inhaling sensitising agents like grain and four dust, isocyanates used in the paint industry etc, halogenated platinum refining – over 200 agents have been recognised;
- VOCs – found in tobacco smoke;
- PAHs – containing formaldehyde found in building materials, e.g plaster board, foam and cavity walls;
- nitrogen dioxide from gas cookers; damp housing conditions;
- pollutants from industry;

  and last but not least

- the current alleged culprit pollutants from vehicle exhausts – oxides of nitrogen, ozone, sulphur dioxide, particulates and benzene.

To illustrate – just two causative agents

1. the high incidence of asthma cases reported in London in June 1994 following heavy thunderstorms which caused high pollen counts in the atmosphere;
2. the large increase in children admitted to hospital with respiratory illness, including asthma, in N. America where high concentrations of ozone of up to 60ppb have been recorded in Los Angeles, Atlanta, New Jersey and Ontario, in separate incidents.

The conference did not come up with any magic cure or definitive measure of prevention or relief; neither did it point the finger at any one cause in isolation, nor exonerate many of the suspect substances. It just amply illustrated the complexity of the disease and its many causes.

Over three million people in Britain suffer from asthma, including more than one million school children. It is the most common chronic illness to affect children, resulting in more time off school than any other condition. One hundred and thirty-three cases per 1,000 of the population are diagnosed every year; the average mortality rate is c.30 per million spread over all the age groups. The number of cases in children and among the elderly is on the increase, as is the social and financial cost to the nation. It is estimated that the burden on the NHS is now over half a billion pounds, so there is need for further research into the causative agents and improved patient education, monitoring and management to ensure optimum use of NHS resources in terms of cost effective treatment and care.

Perhaps this debilitating and distressing disease should now be included by the Government as one of those key areas of disease affecting the Health of the Nation. *(J.J. Beagle, Hon Secretary, South East Division)*

Correction (Vol. 25, No. 3, p127)

Please note that Mrs Pat Naylor was also Chairman of the Women's Solid Fuel Council, London and Southern Division from 1972-1987.

South West Division

The 1995 AGM was held in September at the Guildhall in Bath. A full meeting re-elected Mr. Hylton Dawson as Chairman and Mr. Peter Gendle as Hon. Secretary.

As a body we do need to get the right message across and the Division has therefore decided to appoint a public relations expert. To this end Dr. Richard Lawson will now handle media and newspaper enquiries. His remit, alongside promoting the activities of NSCA, will be to give a balanced view on local events and issues, in which the Society may be involved.

Away from the more formal aspect of the Society the Division has been able to offer the membership a wide variety of seminars and visits. The highlight of the year was the visit to the windfarm, run by National Wind Power at Coldnorthcott, Cornwall. In addition to observing the nuts and bolts of wind turbine construction and power generation, we were able to discuss, at some length, the wider aspects of power supply with particular emphasis on the role of wind power in the next century. *(Peter Gendle, Hon Secretary, South West Division)*

PARTICLES

NSCA welcomed the Expert Panel on Air Quality Standards (EPAQS) recommendation of 50 $\mu g/m^3$ as a 24-hour running average for PM_{10} in the United Kingdom. In their report published in early November, EPAQS also recommended that the standard should be reviewed after a period of, at the most, five years in the light of new data.

In noting that it was a challenging standard, NSCA said that the Government should acknowledge that even at this level particulate pollution will cause some death and illness. A report from the World Health Organisation suggests that a city of a million people experiencing a 3-day PM_{10} episode of 50 $\mu g/m^3$ (which is not unusual in the UK) would expect four extra deaths and 1000 asthma "symptom exacerbations".

An analysis of PM_{10} monitoring data undertaken for NSCA by David Muir of Bristol City Council suggests that the likely number of exceedances of the proposed EPAQS standard may be nearly double that suggested by them. Table 2 of the EPAQS report shows exceedances based on a *daily* average concentration – i.e. measured from midnight to midnight. However, the recommended EPAQS standard of 50 $\mu g/m^3$ is based on a 24 hour *running* average. Analysis of data from the DOE Automated Urban Network shows that, when compared with midnight to midnight averages. PM_{10} exceedances would be expected to be registered on nearly twice as many days using the running average recommended by EPAQS. A copy of David Muir's analysis can be obtained from Tim Brown at NSCA.

Thus NSCA says, it is important that we use the five year review period recommended by EPAQS to improve our understanding of the sources, nature and effects of particulates, identify and deal with pollution blackspots and develop methods of abating and avoiding emissions.

NOISE FROM CAR STEREOS AND RADIOS

The Department of Transport is currently considering whether current legislation is adequate for preventing excessive noise from road vehicles – in particular car radios and stereo systems.

Existing legislation which can be used includes the *Noise and Statutory Nuisance Act 1993* (NASNA) which covers noise in the street which is prejudicial to health or a nuisance; the *Environmental Protection Act 1990* contains powers to deal with noise nuisance when vehicles are not on the highway; and s.62(1) of the *Control of Pollution Act 1974* prohibits (with various provisos) the use of a loudspeaker in the street between 2100 and 0800 – here the test is reasonable cause for annoyance, rather than nuisance.

NSCA Comments

1. The Scale of the Problem

Comments from NSCA member authorities suggest that actual numbers of complaints to local authorities are low – typically of the order 10-50 per year. Some authorities do not record complaints about vehicles separately from other nuisance complaints. This masks what is perceived to be a reasonably widespread problem and one which might be expected to attract more complaints, if the public were aware of an effective means of resolution. Anecdotal evidence suggests that warm summer weather is a contributory factor, since vehicle windows are more likely to be open. However noise levels in some vehicles are high enough to cause annoyance even when windows are closed. Nuisance and annoyance are caused both by moving vehicles which are parked or queuing; we anticipate that the problem is likely to increase.

2. Enforcement Issues

There is confusion over which legislation should be used to control noise from car stereos and radios – and who should enforce it. NSCA would welcome a clarification and strengthening of enforcement powers; not only is this a noise nuisance issue, but there is also concern about the road safety implications of reductions in driver awareness caused by excessive stereo volume.

Noise from stationary vehicles is more likely to represent a statutory nuisance and can be dealt with by local authorities under NASNA or the EPA, as appropriate; however, this requires the protracted exercise of a DVLA enquiry, or the cooperation of the police to identify the registered keeper through the Police National Computer. Efforts to trace drivers through DVLA have often proved difficult – ownership is sometimes routinely changed to hamper identification of responsible driver and registered keeper.

Stereo noise from moving vehicles is transient and unlikely to represent a statutory nuisance under NASNA. However, it certainly gives rise to annoyance, and given the driver/owner identification problems it would seem appropriate for police officers to use their stop powers to identify offending drivers, and to take enforcement action – either directly under the Construction and Use Regulations 1986 (C & U), or in association with local authorities using COPA.

The suggestion attributed to the police (in the DOT's consultation paper) that "*...powers under C & U are more appropriate ...*" is surprising. There is a primary role for police control over moving vehicles, which is supplemented by a local authority enforcement role over stationary vehicles. Local authority enforcement is still dependent upon the police in two respects – stopping offending vehicles to allow action under COPA, and facilitating rapid access to the Police National Computer to allow action under NASNA.

Effective noise control requires not only workable powers but also commitment to enforcement, and it must be said that local authorities appear more willing than the police to take responsibility for noise control. In contrast to the DOT consultation letter, it is extremely disturbing to find the police distancing themselves from noise enforcement issues generally. The 1995 Home Office *Review of Police Core and Ancillary Tasks* seeks to reduce the commitment of the police to noise control and foresees an increasing role for environmental health officers. As with other noise issues – noisy parties and intruder alarms – signals from the Home Office suggest that the police will adopt an increasingly hands-off attitude, at a time when the Government says it wants to do more to control noise.

Conclusions

Further action to combat car stereo noise is necessary. NSCA believes that the following would improve the regulatory framework:

- amend the s.62(1) COPA noise in the street provisions to apply to the use of a loudspeaker at any time, operated in such a manner as to give reasonable cause for annoyance;
- extend the provisions of the C & U Regulations to include noise from stereos from vehicles in use – this would reinstate the powers which were already assumed to exist.

Noise control depends crucially upon good working relationships between local authority officers and the police. Using a combination of existing and modified powers, police and local authorities acting together will be much more effective than either agency acting alone. This is an important area of public concern which demands a new recognition from the Home Office that noise control is a core task which the public

expects the police to fulfil. It also demands commitment from local authorities to provide the resources for environment officers to undertake a collaborative enforcement role.

NSCA POLICY DOCUMENTS AND REPLIES TO CONSULTATION DOCUMENTS July - December 1995

Amendment to Regulation 61 of *Construction and Use Regulations* –exhaust emission requirements; Department of Transport, 13 July.

Revisions to *Prescribed Processes & Substances Regulations* (SI 472); Department of Environment, 21 July.

DOE/MAFF/WO Guidance to the Environment Agency under the Environment Bill on its Objectives; 31 July;

Noise & Statutory Nuisance Act 1993 – draft Regulations on audible intruder alarms; Department of Environment, 16 August.

HMIP Process Guidance Note on Combustion & Carbonisation: Gasification of Solid and Liquid Feedstocks including IGCC; 18 August.

NSCA Report: Local Authority Dirty Diesel Detection Days; 26 September.

Planning Policy Guidance Note 6: Town Centres and Retail Development; Department of Environment, 29 September.

NSCA Environmental Review: first update; September 1995.

Road Humps Regulations – deregulation; Department of Transport, 16 October.

Department of Environment Research Project: Environmental Impact of Traffic Associated with Mineral Workings; 6 November.

Noise from Car Stereos and Radios; Department of Environment, 13 November.

Road Vehicles (Construction & Use) Regulations 1986, amendments to Regulation 57A – marking requirements for moped silencers; Department of Environment, 1 December.

NSCA ON THE INTERNET

NSCA now has its own website at http://www.mistral.co.uk/nsca. This will be updated regularly to provide information on policy, publications and events.

NSCA can also be contacted by Email: cleanair@mistral.co.uk.

REPORT

STACK HEIGHTS FOR DISCHARGES CONTAINING VOLATILE ORGANIC COMPOUNDS (VOCs)

D.J. Hall
Building Research Establishment

SUMMARY

This report discusses the determination of stack heights for discharges of Volatile Organic Carbon Compounds (VOCs) from two specific processes – vehicle respraying and foundry processes. In doing so it also spans the variety of problems likely to arise in dealing with most processes emitting VOCs, since these two specific processes are near the extremes of the range of types likely to be encountered. At one extreme there are those processes, like vehicle respraying, in which the VOC discharge is the major pollutant, whose polluting potential is closely defined by the input solvents and their rate of usage. At the other extreme are those processes, like foundry activities, where the discharge may contain a very wide range of VOCs, not all of which are readily identifiable as some are high temperature degradation products from the process. Also, the VOCs may be only one component of a variety of pollutants in the discharge.

The application of HMIP Guidance Note D1 for VOC discharges is discussed, both for health effects and for odours. Though the Guidance Note can be applied to these processes perfectly well as it stands, in practice its use leads to complex calculations in many cases. In order to alleviate these practical problems, some possibilities for simplified procedures are proposed for both types of process. These proposals are tentative and intended for initial consideration by interested parties.

As part of this discussion the level of background concentrations of VOCs, which is needed for using Guidance Note D1, is examined. For most practical purposes in determining discharge stack heights, background levels can be considered to be negligible.

1. Introduction

The HMIP guidance note D1 (HMIP, 1993), which provides a method for calculating stack heights for Part B processes, requires calculation of a Pollution Index P_i for polluting discharges in the form,

$$P_i = \frac{D}{G_d - B_c} \times 1000. \quad (1) \qquad (1)$$

where,
P_i is the Pollution Index,

D is the rate of discharge of the pollutant in g s^{-1},
G_d is the guideline concentration in mg m^{-3} and
B_c is the background concentration.

This procedure was implicitly intended to apply to all types of polluting discharge. It requires both guideline and background concentrations for values of the Pollution Index to be calculated. However, the guidance makes no specific reference to guideline and background concentrations for pollutants other than those most commonly occurring. This was because information on guideline concentrations was limited to the eight materials (acid gases, particulate, CO, ozone and formaldehyde) for which historical evidence, specific legislation or adequate research data could readily provide short term values. The information on background concentrations was again restricted to the common pollutants (mainly acid gases and lead) for which there existed a good body of monitoring data and which comprised the major atmospheric pollutants. Tentative estimates of background levels of particulate were also provided, though there was at that time very little monitoring of any fraction of the ambient particulate mass, because of what was felt to be its importance. The background levels of other pollutants were assumed to be negligible for stack height calculation purposes. Though there were good grounds for this assumption in many cases, a general lack of data on other background pollutants made it difficult to demonstrate quantitatively. This general deficiency of adequate guideline and background concentrations was specifically discussed in the background report to the guidance (Hall and Kukadia, 1993). It was presumed at the time that more detailed attention to this problem generally, and to specific types of discharge in particular, would eventually be needed.

Thus the Guidance does not refer specifically to VOCs. It only suggests that, lacking more specific advice, Pollution Indices should be summed for particular groups of pollutants of similar type. Organic solvents are suggested as one of these groups. Estimation of guideline concentrations of VOCs is based on the default condition of taking 1/40 of the STEL from the HSE's list of Occupational Exposure Limits (HSE, 1995). Nor does the Guidance provide any information on their background concentrations. At the time it was prepared (the first draft was produced in 1991) there was very little information on background levels of VOCs, nor was it practicable at that time to deal in detail with the great variety of processes for which the guidance would have to be used. However, since the guidance was prepared there has been a considerable increase in published data on ambient VOC levels, so that it is now possible to consider background levels more carefully than previously.

A particular problem which occurs with many types of VOC discharge is that discharges may contain a large number of individual elements, not all of which are clearly identifiable or their discharge rates known with any accuracy. Though the Guidance provides a means for dealing with multiple discharges by summing Pollution Indices, the complexity of the summation process and its inherent uncertainties pose a number of practical difficulties in these cases.

The other major aspect of VOC discharges is that of odour nuisance, which is not covered by Guidance Note D1 at all. This omission was deliberate, due to the difficulties of dealing with odorous discharges and to the very limited information available on the subject. However, for many VOC discharges, odour nuisance may be the determining

factor for the stack height rather than health effects. It has been considered recently in more detail by Woodfield and Hall (1995) and by Hall and Kukadia (1994).

Two particular types of VOC discharge are of current interest and led to the need for the present note. These were discharges from vehicle respraying and from foundry processes. In vehicle respraying, the major discharged pollutant group is organic solvents, though there may also be vapours from the individual components of two-part paints, paint particulate from overspray and more complex products from oven paint baking processes. In foundry processes the VOC discharges arise from the components of the mould materials, including some solvents, and may comprise a very wide range of materials from a variety of different mould producing techniques. Discharges may be from several parts of the process, mould core manufacture and dressing, melting oily scrap material, casting, knocking out, sand reclamation and oil quenching. Furthermore, the discharges may be of VOCs other than those input to the system. There are high temperatures in many parts of the process, including some mould manufacturing processes; thus some components of the VOC discharges may be of high temperature decomposition products or the equivalents of products of combustion as the casting temperatures of many metal alloys are comparable to combustion temperatures. There may also be other pollutants besides VOCs from the pouring and knocking out processes, including particulate and acid gases.

Thus these two processes cover the range of problems likely to be experienced in most VOC process discharges. Firstly, those processes in which, as with vehicle respraying, the discharged VOCs are largely identical to the input material, so that they are clearly defined in both nature and quantity. They also comprise nearly all of the discharged pollutants. At the other extreme, as with foundries, are those processes in which a complex mixture of VOCs is discharged, part of which is produced by the process, and in which the VOC discharge is only a part of the total polluting discharge.

The present note covers in more detail the problems of dealing with stack height calculations for discharges containing VOCs, including an assessment of background concentrations and their significance to stack height calculation. It does so by dealing with the problems of vehicle respraying and foundry processes in turn and then briefly considers VOC background concentrations. Both health effects and odours are covered. Based on the practical problems associated with these two processes, a number of possible procedures are proposed for simplifying stack height calculations for VOCs.

2. VOCs from Vehicle Respraying

There are two main difficulties in dealing with discharge stack heights for solvent and other discharges from vehicle respraying and similar activities. These are, firstly, the relative importance of odours as against health effects in the discharge and, secondly, the problems associated with calculating Pollution Indices for the combined effect of the wide range of materials usually discharged.

For health effects due to similar types of pollutant, the Guidance simply requires summing the individual Pollution Indices to provide a combined value of the Pollution Index for stack height calculation purposes. Though there is no specific example in Guidance Note D1 dealing with VOCs, the procedure is similar to that for acid gases, for

which three examples are given. Summing the Pollution Indices is not difficult in itself, but arriving at the point of being able to do so can cause some practical problems, which are described below.

For odours, a procedure for using the guidance has been given by Hall and Kukadia (1994). An odour threshold for the pollutant is required and there has to be a correction to the effective Pollution Index (currently a factor of ten is suggested) to account for the short term fluctuations in concentration that occur during dispersion and to which the nose responds. Information on additive effects on odour perception from combinations of materials is limited, but suggests that it is the individual odour thresholds that are significant. Thus the single largest odorous discharge in a mixture is the critical determinant of stack height; there is no summation of the individual components.

Table 1 shows a list of a few representative examples of solvents commonly used in paints and solvents for vehicle respraying. A full list would cover over a hundred organic compounds. Against each material is noted, where a value exists, the Short Term Exposure Limit (STEL) of the Occupational Exposure Limit (OEL) and the odour threshold (OT) in mg m^{-3}. The STEL is taken from the HSE Occupational Exposure Limits Document (HSE, 1995) and the odour thresholds from Woodfield and Hall (1994). These are followed in the Table by the values of the STEL/40, which are used for calculating the normal Pollution Index, and OT/10, which are used for calculating a pollution Index for assessing odour nuisance following the procedure laid down by Hall and Kukadia (1994). The Table also gives the ratio of these two figures, (STEL/40)/(OT/10), which indicates the relative significance of odour nuisance and health effects of the material. If the value is greater than unity, then odour nuisance is the dominant factor, if it is less than unity then health effects are dominant. It can be seen that for all of the materials in the Table odour nuisance is the dominant characteristic. However, the uncertain accuracy of odour threshold determinations requires that the ratio needs to be substantially greater than unity for it to be certain that odour nuisance is the dominant problem. In many cases this is so. A feature of the Table is the gaps in it, both for values of STEL and odour threshold, which can often make assessment of discharges difficult.

In practice the relationship between odour and health effects in the discharge is more complex than this. The guidance requires that Pollution Indices be summed for all of the discharged pollutants. However, for odours there seems to be no particular evidence of additive effects of this sort so equivalent Pollution Indices are considered singly. Thus for a mixture of VOCs, the summed Pollution Index for health effects may be greater than individual equivalent Pollution Indices for odour.

The practical aspects of dealing with these calculations raises a number of problems. These are the limited information on odour thresholds, and sometimes a lack of OELs, and the problems of dealing with a large multiplicity of VOCs, including the problems of discovering the VOC content of many paints and solvents.

The general shortage of reliable data on odour thresholds and on additive effects has been remarked upon previously and is also discussed by Hall and Kukadia (1994). Though all the materials in Table 1 have an odour threshold assigned to them, about half the values are of doubtful reliability and a more comprehensive list would show many missing values. These deficiencies are especially important as the author's experience is that odours are most often the dominant factor determining the discharge stack height.

Dealing with a multiplicity of VOCs may require information on the content of both the basic paint and the solvent with which it is thinned. Ten or twenty VOCs can easily be involved. In practice, there are often only a few major pollutants, though it has frequently proved difficult to discern precisely which they are. Most of the enquiries on discharges from vehicle respraying received by the author have involved some problems in determining the range and quantity of VOCs discharged. In principle this should not be a problem as the manufacturers issue safety data sheets on their products which give a breakdown of the solvent content. However, this information does not seem to be generally known, nor do data sheets always detail all components in a proprietary product. Also, the information usually supplied is of the materials currently in use. The range of materials likely to be used, or probable future changes, are not usually considered as it is impracticable to do so. Furthermore, there is often a repetitive quality to the calculations required for the stack height and many enquirers have only a hazy idea of the significance of many of the materials involved. Spray booth operators often seem poorly informed on these matters and it is difficult to reasonably expect them to have a good understanding of the principles involved or to be able to carry out such calculations.

Thus there seems to be a case for considering an improved, simplified, approach to this activity which might resolve many of these practical problems. Some possibilities are discussed below.

For health effects, there is no reason why part of the Pollution Index calculation and summation process could not be carried out by the suppliers of the paints and solvents and provided as a single figure for specific material. Equation 1, for determining the Pollution Index, has the discharge rate of the pollutant, D, as the numerator. However, for mixtures of materials it is possible to split the calculation of the Pollution Index into two parts, separating the proportion of each material, Q, and the rate of discharge, R. Thus a partial Pollution Index, P_p, can be calculated for each material in a mixture using,

$$P_p = \frac{Q}{G_d - B_c} \times 1000. \qquad (2)$$

where Q is the proportion of each material in a unit quantity of the product. The other parameters are as defined in Equation 1.

These values can be summed for combinations of pollutants in the usual way to give a combined partial Pollution Index, ΣP_p. The Pollution Index, P_i, for the combined discharge is then given by,

$$P_i = R \times \Sigma P_p. \qquad (3)$$

where R is the rate of discharge of the product in g s^{-1}.

The important feature of this procedure is that the first part of the calculation can be provided by the supplier of the product. The user can then calculate the second part knowing only the summation provided by the supplier and his own estimate of the rate of discharge. This latter can be found by estimating the rate of evaporation of the sprayed solvents, which is usually known approximately. There is no longer any need for him to know the constituents of the product or its STELs or to carry out a multiple summation

calculation. Where both a paint and a solvent are used, the same procedure can be used for each and the resultant Pollution Indices added together as usual. This approach is similar to that used in the HSE's *Occupational Exposure Limits* guidance (HSE, 1995) under "Mixed Exposures", where they provide a method for calculating "in-house" OEL's for mixtures of pollutants, mainly aimed at hydrocarbon solvent mixtures.

For odours, a similar approach could be used and would be highly desirable due to their frequent dominance in stack height calculations. Thus in the same way as Equation 2 gives a partial Pollution Index, its odour equivalent can also be provided for a product, which can be used to estimate the total odour discharge. The potential odour nuisance of a product could be predetermined either from a direct measurement of its odour threshold or from the odour thresholds of the constituents (if known). Also the relative magnitudes of health effects and potential for odour nuisance could be predetermined, as for example in Table 1.

Procedures of this sort would be much easier for the end-user to carry out and to understand. It also opens the practical possibility of classifying spray booths by their capacity to handle given quantities of specific materials, which can be estimated fairly easily by the end user. Health effects and odour would still need to be considered separately due to their different relative importance in different circumstances. There is an obligation under the *Environmental Protection Act* to set adequate stack heights to deal with health effects. However, odour nuisance does not formally occur until a complaint has been received and this probability is influenced by a number of factors in individual installations.

There are some other features of paint spray discharges which would merit further attention. For example some two-part paints using epoxies and isocyanates use relatively little solvent. The component parts of the paints may have low STELs, but the reacted mixture will be of relatively low toxicity. The proportion of unreacted material in the spray can thus be critical to determining the Pollution Index, but there is little published information on this subject.

With the moves towards compliant coatings with much lower organic solvent content, it might be presumed that the problems described above will diminish with the passage of time. However, this may not be the case. It is expected that respraying will continue to use high solvent content paints, especially by small scale operations, for some years. Also, the compliant coatings with lower solvent content are presently using water miscible organic compounds (glycol ethers for example) which can be both toxic and have a high potential for odour nuisance. This applies particularly to degradation products of stoved paints, for which water-based paints are rapidly becoming the dominant material.

3. VOCs from Foundry Processes

VOCs from foundry processes are mainly associated with the binder chemicals used in moulded core production. There is a wide range of binder products and these may contain a great variety of organic compounds. Also, binder products are constantly reformulated by their suppliers. Moulds may be prepared cold or at temperatures up to 300°C. VOC discharges can occur during mould manufacture, casting, knock out and sand reclamation. Because of the high temperatures when pouring and during some moulding processes,

high temperature decomposition products, similar in some ways to partial products of combustion, can occur. Though there has been some investigation of the VOC content of discharges from foundry processes (little of it is published), there seems to be only limited recent information, despite many changes in mould production processes. There have been some useful reviews of discharges from US foundry processes, by Mosher (1994) and by McKinley et al (1993), though some of this is based on older UK data.

A significant proportion of emissions from foundry processes are vented adventitiously, to some extent due to the impracticability of any alternative approach, and only the more toxic or offensive emissions are collected and discharged through ducted systems. Examples of the latter are emissions from phenolic urethane and resin shell core moulding processes. Both particulate and odour in foundry process emissions can cause nuisance, and complaints occur from both causes. The relevant Process Guidance Notes place restrictions on some particulate emissions, but there are no formal emission limits set for odours or VOC emissions, beyond the general requirement for their limitation contained in most of the Notes.

Some idea of the range of discharged contaminants from this wide variety of processes can be seen from Tables 2 and 3, which are reproduced respectively from Table 3 of the HMIP Guidance note on Ferrous Foundry Practices (HMIP, 1994), which lists the major components of fumes produced by various processes, and from Table 5 of McKinley et al (1993), which gives a more detailed list of discharges from just two types of mould production (McKinley gives data on a total of five different types of mould production process). It will be seen that in these cases the major pollutant groups in Tables 2 and 3 are acid gases, aldehydes, organic solvents and more toxic organic compounds such as Benzo(a)Pyrene.

Some information on VOC Discharge rates from UK based processes has been supplied to the author by Martha McBarron of CTI. A single page of this is reproduced in Table 4 as a typical example of the data. It only covers VOCs, measured as total hydrocarbon. The main point is that the range of discharge rates is very wide. For all the measurements supplied (of which those in Table 4 are only a part) it is between about 10 and 10,000 mg s^{-1}. Most measurements lie in the range 100-1000 mg s^{-1}. Associated breakdowns of the constituents of the total VOCs are not given, but in the first instance could be assumed to be similar to the US estimates quoted above.

In principle, the procedures laid down in Guidance Note D1 can deal with this type of discharge without difficulty, provided that the pollutants and their rates of discharge are known. The most appropriate procedure for this mixture of pollutants would be to consider separately the major groups, those noted in McKinley's data for example. Pollution Indices can be found separately for each group, to find that which comprises the major pollutant and the stack height determined using this group. In practical application, however, it does not seem feasible to use this approach for every individual installation. Identifying the pollutants and their rates of discharge requires sophisticated analytical procedures whose cost cannot be justified for individual emissions. In addition to this, individual stack height calculations would have a repetitious quality which would be best avoided.

Thus, as with the practical problems associated with discharges from vehicle respraying, it is doubtful whether these sort of complex and detailed discharge calculations ought to be carried out for every installation. It would be desirable to see if a simplified method of determining stack heights could be produced. A more rational approach would be:

1) Classify the types of discharge from the different processes.
2) Estimate Pollution Indices for the different pollutant groups and their constituents from analysis of a limited number of representative examples of the process. Relate these to the process throughput. In the case of core moulding, for example, to the rate of binder chemical usage.
3) From these try and identify major pollutants which can be used as emission indicators for the process, or see if it is possible to determine an overall Pollution Index for the process which is solely dependent upon its scale. In cases where odour nuisance is occurring, this should also be accounted for in a similar way to that described earlier for the organic solvents used in vehicle respraying.
4) Use this to determine some sample stack heights. If the discharge is small and calculated stack heights fall within a limited range, it may be possible to recommend a single minimum stack height which would be an acceptable upper bound to nearly all processes of that type. Otherwise individual stack height calculations would still be required, but from a simplified emission database.

It is clear from the variety of pollutants and the wide range of discharge rates shown in the Tables that this would need to be done for each process, at least in the first instance. However, after a first round of calculations it may be possible to identify a few major pollutants which dominate the discharge and which can be used as adequate indicators of overall pollution levels in further studies, ammonia or xylenol for example.

It remains desirable to monitor individual emissions in some useful but simple way. It may be possible to identify a few dominant pollutants which could be measured directly, though this seems unlikely. An alternative would be to relate the scale of the major polluting emissions to some bulk parameters, such as total acidity or total hydrocarbon, which can be readily monitored and used as indicators of major pollutant levels. It is beyond the scope of the present paper to carry out these more detailed analyses, both because of the large number of individual processes involved and because only limited data on the combination of discharge rate and content from UK based processes is available at the time of writing. In particular, there seems to be very little information on the odour content of any foundry emission, despite its known nuisance potential. One useful approach to reducing VOC emissions would be better control over the usage of binder materials, which are sometimes incorporated into the moulding sands a little haphazardly.

4. Background Levels of VOCs

When the stack heights guidance was first produced (during 1991), there was very little information on background levels of pollutants other than the few listed. Thus it was impracticable to offer any detailed guidance of background levels of other pollutant

groups such as the VOCs of interest in the present paper. It was tacitly assumed in the guidance that the background levels of pollutants other than those listed were negligible for stack height calculation purposes.

There has been a much greater interest in VOCs since that date and the publication of some quite detailed measurements. The first QUARG report (DOE, 1993) devotes a chapter to urban VOC levels. There is also a summary of UK air pollution data by Bertorelli (1995), which includes VOCs, and detailed discussions of the components of ambient VOCs by Derwent (1993) and by Field et al (1994a, b).

A high proportion of ambient VOCs are methane, together with a smaller proportion of other low molecular weight hydrocarbons (for example ethane, ethylene, propane) which are not of practical interest for present purposes as they are not classed as toxic pollutants. However, monitoring data has provided the levels of some of the higher molecular weight components. Figures 1 and 2 are from Chapter 9 of the QUARG report and show, respectively, diurnal values of the ambient VOCs from a London site, broken down into its major constituents, averaged over a year and the averaged daily values of toluene and benzene for August 1992, when levels were unusually high. The background levels required for stack height calculation are upper bounds (around 90-95%iles) over short periods (up to an hour). However, it is possible to make some approximate estimates from the data in Figures 1 and 2.

The Figures give concentrations of toluene, xylene, benzene and other higher molecular weight hydrocarbons. A high proportion of the discharges are from motor vehicle emissions and the levels in central London are likely to be amongst the highest values to be expected. From the Figures it can be seen that levels of the higher molecular weight VOCs are of the order of a few ppb, annually averaged, and may be tens of ppb averaged daily during the more severe pollution episodes. Thus it seems that the largest hourly averages may occasionally approach perhaps 100ppb (that is, around 0.5 mg m^{-3}). Reference to Table 1 shows that the values of STEL/40 for the organic solvents are all well above this level. For Toluene and Xylene, for example, they are 14 and 16 mg m^{-3} respectively. Thus even these relatively high background levels of high molecular weight VOCs would increase the calculated Pollution Index only by around 10% and the subsequent stack height by perhaps 5%. Considering the approximate nature of the emission data for both vehicle respraying and foundry processes, it seems doubtful whether it is worth accounting for existing background levels of VOCs in the stack height calculation.

5. Discussion and Conclusions

Guidance Note D1 lays down a clear procedure for dealing with discharges of mixtures of pollutants of different types which in principle is applicable to the two VOC process discharges considered here – VOCs from vehicle respraying and from foundry processes. However, in practice dealing with the complex mixture of emitted pollutants does cause some difficulties. In both cases the emissions are not exactly known and the calculation can become complex. It is doubtful whether it should be necessary to do this for each individual installation.

For both processes it would be possible to produce much simpler methods of stack height calculation based on prior assessment of the processes, for foundries, and the raw materials (paints and thinners) for paint spraying. Suitable approaches of this sort for the two industries have been described. This would clearly need agreement across the particular industry or process sector and the approval of the relevant regulatory authorities, but would considerably ease the practical problems of determining discharge stack heights.

For both the processes considered here, and for activities involving VOC discharges in general, odour nuisance is an important component of stack height determination. It could usefully be the subject of further attention as there is usually insufficient data to assess odorous discharges adequately.

Background concentrations of VOCs can be assumed to be negligible for stack height calculation purposes.

6. Acknowledgements

This report was prepared for, and funded by, the Local Authority Unit of the UK Department of the Environment's Air Quality Division (BRE Client Report CR 167/95). In preparing it the author is indebted to the assistance of Martha McBarron of CTI International Ltd and of Bruno Giordan of Herberts Ltd, who supplied the author with much useful information and helped him to understand their respective industries far better than otherwise. Any errors in this work, however, remain the author's own.

7. References

Bertorelli V. (1995). *Air Quality A-Z. A Directory of Air Quality Data for the United Kingdom in the 1990s*. Meteorological Office, for the Department of the Environment.

Derwent R.G. (1993). Hydrocarbons in the Atmosphere: Their Sources, Distributions and Fates. *Volatile Organic Compounds in the Environment*. Proceedings of the International Conference, London, 27-28 October.

DOE (1993). *Urban Air Quality in the United Kingdom*. First Report of the Quality of Urban Air Review Group, Dept of the Environment. ISBN 0 9520771 1 6.

Field R.A, Goldstone M.E, Lester J.N, Perry R. (1994a). The Variation of Volatile Organic Compound Concentrations in Central London During the Period July 1991 to September 1992. *Environmental Technology*, Vol 15, pp931-944.

Field R.A, Goldstone M.E, Lester J.N, Perry R. (1994b). The Variation in Volatile Organic Compound Concentrations in Central london Between 1986 and 1992. *Environmental Technology*, Vol 15, pp801-812.

Hall D.J, Kukadia V. (1993). Background to the New HMIP Guidelines on Discharge Stack Heights for Polluting Emissions. Warren Spring Laboratory, Report No. LR 929. ISBN 0 85624 840 1.

Hall D.J, Kukadia V. (1994). Approaches to the Calculation of Discharge Stacks for Odour Control. Warren Spring Laboratory, Report No LR 965, 1993. *Clean Air*, Vol 24, No 2. pp74-92.

HSE (1995). *Occupational Exposure Limits*. Health and Safety Executive, EH40/95. Updated Annually.

HMIP (1993). *Guidelines on Discharge Stack Heights for Polluting Emissions*. HM Inspectorate of Pollution, Technical Guidance Note D1 (Dispersion). ISBN 0 11 752794 7.

HMIP (1994). Chief Inspectors Guidance to Inspectors. Ferrous Foundry Practices: HM Inspectorate of Pollution. Environmental Protection Act 1990. Process Guidance Note No. IPR 2/2.ISBN 0 11 752962 1.

McKinley M.D, Jefcoat I.A, Hertz W.J, Frederick C. (1993). Air Emissions from Foundries: A Survey of Currently Available Information from the Literature, Suppliers and Foundrymen. American Foundrymen's Association, 97th Casting Congress. April 24-27th McCormick Place, North Chicago, Illinois, USA. Preprint No. 93-105.

Mosher Gary E. (1994). Calculating Emission Factors for Pouring, Cooling and Shakeout. *Modern Casting*, October 1994, pp28-31.

Woodfield M, Hall D.J. (Editors) (1994). *Odour Measurement and Control, an Update*. AEA Technology, National Environmental Technology Centre. Report No. AEA/CS/REMA-038.

Table 1. Guideline Values for Health Effects and Odour Nuisance for VOCs Related to Paint Spraying.

Solvent	STEL mg m^{-3}	Odour Threshold (OT) mg m^{-3}	STEL/40	OT/10	STEL/40 / OT/10
Acetone	3560	14	89	1.4	64
Butanone	900	0.87	22.5	0.087	260
2-Butoxy Ethyl Actate		0.045		0.045	
n-Butyl Acetate	950	0.047	23.8	0.0047	5100
Diacetone Alcohol	360	1.6	9	0.16	56
Diethanol Amine	45	5.3	1.13	0.53	2
Ethanol	5700	2	143	0.2	720
Hexa Methylene Di-isocyanate	0.07	-	0.0007	-	-
Isobutanol	225	3.3	5.6	0.33	17
Isopropyl Alcohol	1225	1.2	31	0.12	260
Methanol	310	4	7.8	0.4	20
Methoxy Propyl Acetate		0.0075		0.0008	
Methyl Isobutyl Ketone	410	0.54	10.3	0.054	190
Propyl Benzene	-	0.048	-	0.0048	-
Toluene	560	0.6	14	0.06	230
Trimethyl Benzene	369	10	9.2	1	9
Xylene	650	0.08	16.3	0.008	2000

Table 2. Emission Data for Foundry Processes, Taken from HMIP Guidance Note IPR 2/2.

System name and binder constituents	Setting method	Fumes during mixing and setting	Fumes during casting
GREEN SAND Clay Coal dust or substitute Water	Pressure	Dust	Carbon oxides Aromatics (inc polycyclics) Nitro aromatics
SHELL SAND Phenol Formaldehyde (Novalac) Resin	Heat	Formaldehyde Ammonia Phenol Aromatics	Carbon oxides Phenols Ammonia Aldehydes Aromatics (inc polycyclics)
ALKALI PHENOLIC Alkaline phenol Formaldehyde resin 1. Self-setting, eg "Alpha-set", "Novaset"	Cold set with esters	Formaldehyde Phenol Esters	Carbon oxides Formaldehyde Phenol Aromatics
2. Gas hardened, eg "Betaset"	Gas hardened with methyl formate vapour	Formaldehyde Phenol Methyl formate	
PHENOLIC URETHANE 1. Gas hardened, eg "Cold-box", "Isocure"	Amine vapour	Solvents Isocyanate (MDI) Amine	Carbon oxides Nitrogen oxides Monoisocyanates Formaldehyde Phenol Aromatics (inc polycyclics) Anilines Naphthalenes Ammonia
2. Self setting, eg "Novathane", "Pepset"	Self set with substituted pyridine	Solvents Isocyanates (MDI)	
FURANE Combination resins of: Phenol Urea Furfuryl alcohol Formaldehyde	Cold set with acids	Formaldehyde Phenol Furfuryl alcohol Hydrogen suphide Sulphur dioxide Acid mists	Carbon oxides Phenol Formaldehyde Aromatics Sulphur dioxide Ammonia Aniline
HOT BOX Combination resins of: Phenol Urea Furfuryl alcohol Formaldehyde	Heat	Formaldehyde Acids Furfuryl alcohol Phenol	Carbon oxides Nitrogen oxides Formaldehyde Phenol Aromatics Aniline Ammonia
OIL SAND Linseed oil and starch	Heat	Acrolein Complex organics	Carbon oxides Butadiene Ketones Acrolein
CO_2 PROCESS Sodium silicate	Gas hardened with CO_2 gas	None	Carbon oxides
SILICATE ESTER "Self set" Sodium silicate	Cold set with esters	Esters	Carbon oxides Alkanes Acetone Acetic acid Acrolein

Table 3. Example of Emission Data for Foundry Processes, Taken from McKinley et al(1993).

Chemical	Concentration (mg/m^3) by Binder Systems				
	Alkyd Isocyanate	Phenolic Urethane	Phenolic No-Bake	Low N_2 Furan-H_3PO_4	Med N_2 Furan-TSA
Sulfur dioxide	1.1	1.4	310.0	15.0	120.0
Hydrogen sulfide	0.2	1.3	30.0	10.0	12.0
Hydrogen cyanide	4.8	24.0	0.6	9.1	15.0
Ammonia	1.0	1.9	0.8	1.0	5.0
Nitrous oxides	9.7	1.0	0.6	0.3	7.7
Formaldehyde	2.9	0.5	0.2	6.6	1.6
Acrolein	2.4	0.7	0.1	0.7	0.4
Total Aldehydes	59.0	<5	63.0	6	420
Total Aromatic Amines	<1	8	<1	2	9
Benzene	146	122	230	16	112
Toluene	42	19	13	3	218
m-Xylene	69	10	2	55	6
o-Xylene	105	3	<1	18	1
Napthalene	1	<<1	<1	<1	1
Phenol	3.0	89.0	20.0	0.6	2.5
Furfuryl alcohol	--	--	--	1.6	0.2

Particulate Fraction

Compound	Emission (μg/g particulate) from Binder Systems.	
	Furan	Urethane
Acridine	<0.6	<0.6
Napthalene	<0.6	12
Carbazole	<0.6	<0.6
Phenanthrene	31	230
Benzo(a)anthracene \ Chrysene /	<0.6	5.4
Benzo(a)pyrene	<0.6	<0.6
Dibenzo(a,h)anthracene	<0.6	<0.6

Water Soluble Fraction

Compound	Emission (μg/g sample) from Binder System	
	Furan	Urethane
Phenol	2000	50000
Pentachlorphenol	3	<2
4-Nitrophenol	48	420
2-Nitrophenol	<2	<2
2,4-Dimethylphenol	<2	21

Table 4. Example of Emission Data for Foundry Processes, from CTI Measurements. Resin Shell Moulding/Core Making/Dressing

	VOC Concentration at STP (mg m^{-3})	Velocity (m s^{-1})	Volume Flow Rate (m^3 s^{-1})	Annual Mass Release* (tonnes)	VOC Discharge Rate (mg s^{-1})
Core Machine	13	9	0.44	0.03	5.7
Core Bench	17	8.5	0.96	0.11	16.3
Moulding	21	10	1.19	0.15	25
Mould & Core Making	25	8.3	2.57	0.4	64
Core Making	46	17	6.25	1.8	290
Core Making	52	3.5	1.09	0.4	57
Moulding	68	9.5	2.26	0.9	154
Multiple Core Benches	97	18	10.5	6.3	1018
Moulding & Dressing	98	7.7	3.5	2.1	340
Moulding	103	5.9	1.2	0.7	124
Core Benches	108	13	7.9	5.3	853
Core Machine	131	9.3	6.2	5.0	812
Core Dressing	187	8.3	1.5	1.7	280
Core M/c's & Benches	256	11	2.1	3.3	540
Core Machine	315	19.5	13	25	4095
Core Machine	367	7.8	1.8	8	660
Means:	119	10	3.9	3.8	

* Assumes 40 hours per week, 46 weeks per year of production.

Table 4 (continued). Example of Emission Rate Data for Foundry Processes, from CTI Measurements. Data on Emissions from Burners.

	VOC's Concentration Burners Only (mg m^{-3})	VOC Concentration During Production (mg m^{-3})
Core Machine	9.3	13
Moulding	58	103
Core Machine & Benches	85	256

Figure 2. Variation of High Molecular Weight VOCs (Daily Averages) during a High Concentration Episode. (Taken from the First QUARG Report, Chapter 9)

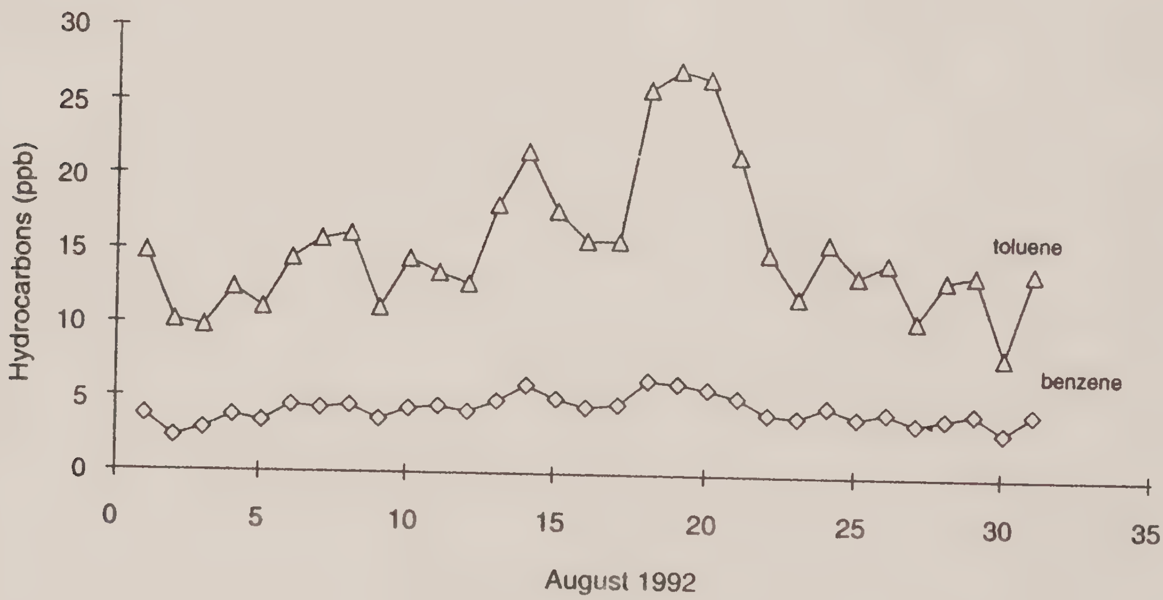
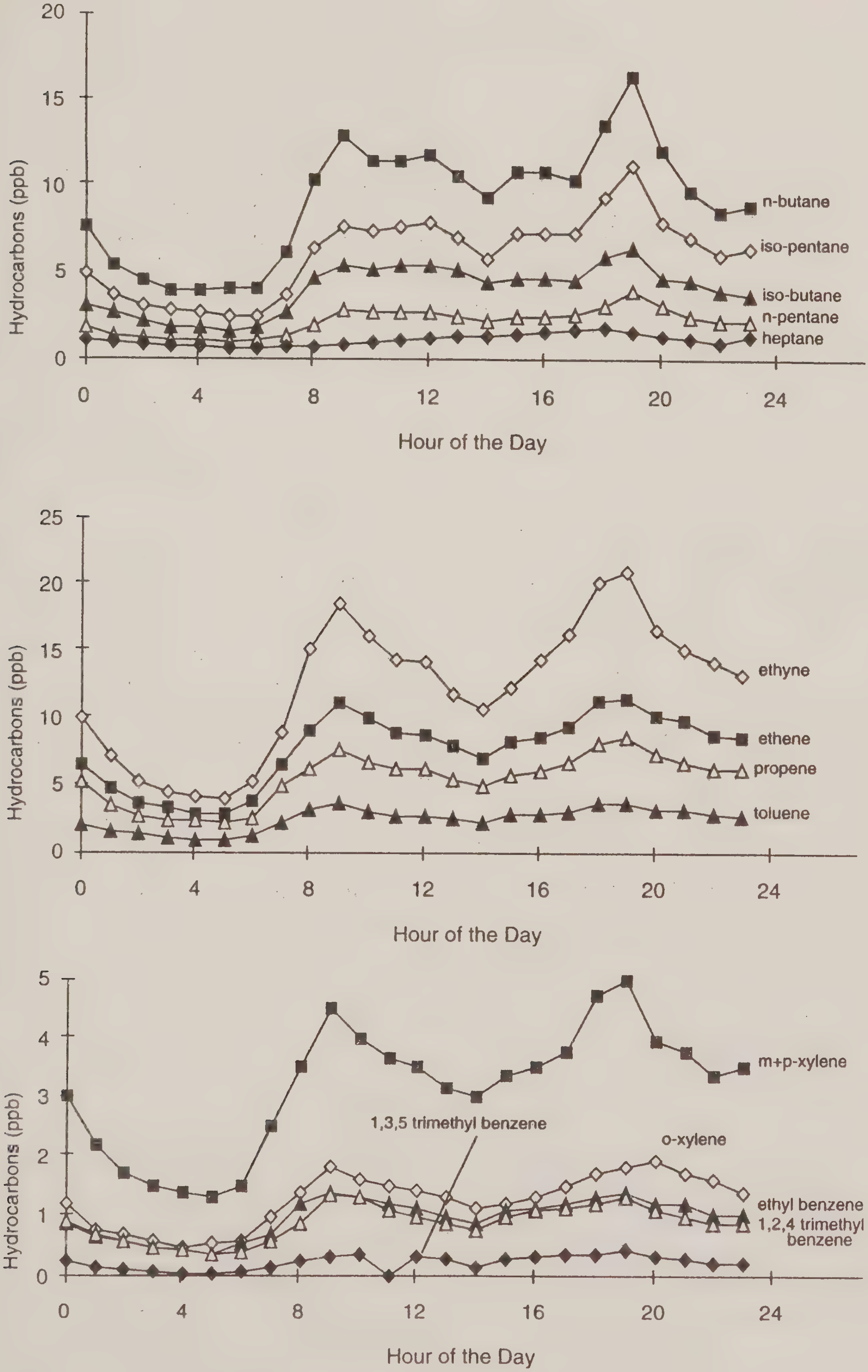


Figure 1. Breakdown of Ambient VOC Levels (Annual Averages) and their Diurnal Variation. (Taken from the First QUARG Report, Chapter 9)



UPDATE

ENVIRONMENTAL ANALYSIS CO-OPERATIVE

The Environmental Analysis Co-operative was formed in November 1994 following an initiative by Dr. David Slater, then Chief Inspector, HMIP and now Director of Pollution Prevention and Control of the Environment Agency. It is a group of some 50 organisations with representatives from industry, trade associations and environmental organisations. It has set itself the task of producing guidance and associated tools on the methods of environmental analysis in support of applications under IPC.

The group has now produced a guidance document on the steps that can be followed when conducting an environmental analysis. It will be launching the document on 27 March at the Institution of Mechanical Engineers with a conference, when the future plans of the Co-operative will also be discussed. For further details contact Anna Ioannou, Fax: 0171 357 0961.

AIR QUALITY A TO Z

Invaluable air quality data for 249 trace gases and air pollutants, including greenhouse gases, ozone depleting chemicals, toxic and aggressive urban pollutants, VOCs, trace elements, toxic organic micropollutants and PAHs has been compiled by the Met. Office for the Department of Environment.

The data compilation is expected to be of particular help to all those involved in planning, regulating or managing local air quality. Data are provided for rural, urban, kerbside and industrial locations (where available) and both IUAPC and common names are used for organic compounds.

The A to Z costs £10 and copies are available from the DoE's Air Quality Division, 43 Marsham Street, London SW1P 3PY.

ENVIRONMENTAL STANDARDS

The Royal Commission on Environmental Protection is currently collecting evidence for a report on environmental standards. In particular it is examining whether a more consistent and robust basis can be found for such standards.

The RCEP will compare the methods and procedures adopted in arriving at standards for all types of pollution and for all aspects of the environment. It will look at what happens both in Europe and in other major countries.

The RCEP hope to publish its report in 1997.

OZONE LAYER PROTECTION

Meeting in early December, parties to the Montreal Protocol on the protection of the ozone layer have agreed a further set of controls on ozone depleting substances.

For developed countries, the meeting agreed a 25% cut in the use of methyl bromide by 2001, followed by a 50% cut by the year 2005, with phase out by 2010; certain critical agricultural uses will be exempted. For HCFCs, the cap on consumption is reduced from 3.1% to 2.8% and the deadline for phase out is brought forward ten years to 2020 (subject to limited exemptions).

Developing countries have agreed to freeze production and consumption of methyl bromide in 2002, with the scope for further controls and phase out being discussed again in 1997. Developing countries are also to freeze consumption of HCFCs in 2016 and to phase them out by 2040.

LAAPC – PETROL VAPOUR

A Direction and Notice bringing into force the EC Directive "on controlling VOC emissions resulting from the storage of petrol and its distribution from terminals to service stations" is expected shortly. This Directive – "Stage 1" controls: 94/63/EC – was agreed in December 1994. The Prescribed Processes and Substances Regulations have also been amended to extend their coverage to relevant processes.

As a first step, new processes for the storage, loading and unloading of petrol at terminals and for the unloading of petrol into storage at service stations became subject to LAAPC under Part I of the *Environmental Protection Act 1990* on 31 December 1995. The Department of Environment has now circulated drafts of two Process Guidance Notes (PG 1/13(96) and PG 1/14(96), respectively) which are expected to be finalised soon.

OXFORD TRAFFIC STUDY

Oxford City Council has secured European Commission funding of £1 million for its "Environmental Monitoring of Integrated Transport Strategy" (EMITS) study. The project was expected to start early in 1996 and continue for five years.

The study will investigate the complex relationships between changes in traffic levels and air pollution, public health and the erosion of Oxford's historic buildings and structures. The project will also assess the environmental and health effects of the progressive introduction of the Oxford Transport Strategy measures which include closures of the High Street to through traffic, and the pedestrianisation of Cornmarket Street as well as the progressive introduction of improved buses with low emissions engines or electric power.

The EMITS' partners are Oxfordshire County Council, Oxford City Council, the National Heart and Lung Institute, the Oxford University School of Geography and the Oxford Transport Studies Unit.

GAS-POWERED BUSES

With the support of Hampshire County Council and the Department of Transport, Southampton Citybus is converting six of its buses to natural gas; a further 10 purpose-built gas-powered buses will be operation by March 1996.

As part of a ten year vehicle gas supply agreement, British Gas are to build, equip and operate a natural gas filling station at the bus company's premises. Southampton Citybus will pay only for the fuel.

It is hoped that this initiative will pave the way for a rapid increase in the

use of natural gas as a vehicle fuel in the UK. The option of having a filling station on the premises would solve any fuelling infrastructure problems faced by other commercial fleet operators who want to convert to gas as a cleaner fuel but have no filling station nearby.

ENVIRONMENTAL MANAGEMENT TRAINING PACK

A new training pack developed by the Open University and Business in the Environment aims to help companies improve their profitability via good environmental management.

Intended for use either as a self-help guide, or as the basis of a short training course, *Profit from Environmental Management* is equally relevant to all sizes of organisation. It has been designed to act as a tool kit to help any organisation carry out its own environmental review and includes audio cassette, workbook and a video with four case studies.

The pack costs £105 and is available with a 14 day, money back guarantee from The Open University, Tel: 01908 653338.

INDOOR AIR

Almost everyone in a computerised office is now exposed to dry heat from visual display units (VDUs). Because VDUs dry the moisture out of the air, the air takes the moisture it needs from wherever it can find it, such as eyes, nose, throat and skin. This produces symptoms such as dry eyes, throats and skin, headaches, tiredness and lethargy, colds and flu symptoms – most of these are typical of "sick building syndrome" (SBS). According to the World Health Organisation and the House of Commons Environment Committee, 6% of staff sickness/absenteeism is due to SBS, costing the UK economy between £330 million and £650 million a year.

The *Health & Safety (Display Screen Equipment) Regulations* which implement EC Directive 90/70 require employers to ensure that "an adequate level of humidity is established and maintained" in offices where there are VDUs (HSE Guidance). These Regulations are now law for new or modified workstations; the date for compliance for unchanged workstations is 31 December 1996. Compliance with the Regulations is monitored by EHOs and HSE inspectors. *(Source: Air Improvement Centre)*

WASTE REGULATIONS

New special waste regulations replacing the current 1980 regulations are due to be laid before Parliament by 1 April and to come into force in the summer.

The Department of Environment has also announced that measures will be proposed later in the year to extend waste management controls to certain types of agricultural and mining and quarrying waste; provisions about consulting and compensating those with rights in land adjoining waste facilities will also be proposed, with a view to these taking effect by the end of 1996.

GOODBYE NAWDC, HELLO ESA

On 22 November NAWDC was formally re-launched as the Environmental Services Association (ESA).

The new name (and a new Constitution) reflect the wider role of the waste disposal industry, which now embraces all aspects of waste management from recycling, waste-to-

energy and other forms of waste treatment to some of the privatised municipal services, such as refuse collection.

DOMESTIC NOISE NUISANCE

In December the Government announced a package of measures aimed at tackling the problems of noise nuisance from domestic premises (see also *Clean Air*, Vol. 25, No. 2, pp50-55). The package includes clearer powers of temporary confiscation of noise-making equipment, and the creation of a new criminal offence to apply to night-time neighbour noise disturbance. Legislation to implement these measures is being included in a Private Member's Bill being promoted by Harry Greenway MP.

In the case of night-time noise nuisance, an offence will have been committed if a noise maker fails to reduce noise to below 35 dB(A) following a warning from a local authority officer. There would be a fixed penalty set initially at £40 or alternatively the offender could be prosecuted by the local authority. This new offence would supplement the existing statutory nuisance regime and local authorities would have a choice as to whether or not to adopt it for their area.

CHEMICAL RELEASE INVENTORY ON THE INTERNET

As part of its Right to Know Campaign, in October 1995 Friends of the Earth launched an interactive map of HMIP's Chemical Release Inventory on the Internet.

Information on registered processes has been superimposed on postcoded maps of England and Wales. By entering a postcode, local industries and their emissions can be instantly accessed. Explanatory information and links to HMIP's Home page and the US EPA substance factsheets make this an invaluable resource.

According to FOE, within hours of going online more people had visited the site than consult HMIP registers in a year.

FOE's CRI can be found at http://www.foe.co.uk/cri.

BOOKS AND REPORTS

THE FUTURE OF ENERGY USE

R. Hill et al. Earthscan, 1995. £14.95 ISBN 1853831077.

The availability and price of energy and the technologies for transferring it into goods and services are central issues in sustainable development. This book outlines the concepts and provides detailed figures on energy consumption and output necessary for the reader to appreciate the complexities of its subject. It examines the uncertainties of estimating non renewable resources and the potential of techniques of exploiting renewable resources. Appendices on units and conversion factors and cost-benefit analysis make this the source book we have been waiting for.

REFORMULATED GASOLINE: Lessons from America

A. Seymour – Oxford Institute for Energy Studies, 1995. £14.00, ISBN 0984061.

An economist's perceptive account of the logistics, economics and politics of gasoline reformulation required by the 1990 amendments to the *Clean Air Act* in areas which do not meet air quality standards for ozone. The study discusses briefly the effect of reformulation on tail pipe emissions but does not address the environmental impact of these effects. It is therefore of interest to those who will have to formulate Air Quality Management strategy and plans in the UK. However they would have to read more widely to form a complete appreciation of the subject.

HEALTH EFFECTS OF ULTRAVIOLET RADIATION

Report of an Advisory Group on Non-Ionising Radiation. Documents of the NRPB, Vol. 6 No.2. HMSO, 1995. £20.00. ISBN 0859513874.

This statement provides advice on the protection of health from exposure to ultraviolet radiation, following a review of the health effects of UVR by NRPB's Advisory Group on Non-Ionising Radiation. The advice applies to the public and to those who are occupationally exposed. Incidence of malignant melanoma in the UK is now approaching 10 new cases per 100,000 – more than double the rate 15 years ago, causing 1 in 12 cancers in 20-39 year olds. NRPB recommends that hats, clothing and sunglasses should be worn as protection against UVR, avoiding prolonged exposure to sun, early consultation if suspicious skin changes occur and that sunbeds for cosmetic purposes be discouraged.

AVIATION, THE ENVIRONMENT AND PLANNING LAW

A. Bingham, Aviation Environment Federation, 1995. £20.00 + £1.00 p&p. ISBN 1900211009.

Intended as a reference book for professionals and organisations, this handbook examines how planning law in the UK may be used to control the environmental impacts associated with aerodrome development and operation. It addresses the importance of the planning system as a tool for assessing, controlling and enforcing a framework of controls for the operation of aerodromes.

TRADING WITH THE ENVIRONMENT
Ecology, Economics, Institutions and Policy

T. Andersson et al. Earthscan, 1995. £13.95. ISBN 185383260.

This book examines the dependence and the effects of international trade on the life support systems of the earth. It looks at ways in which trading regulations could be adapted to promote ecologically sustainable economic development, and sets out 16 recommendations that would help achieve sustainable trading at both national and international level.

METHODS TO ASSESS THE EFFECTS OF CHEMICALS ON ECOSYSTEMS
SCOPE 53

Ed. R.A. Linthurst et al., Wiley, 1995. £65.00. ISBN 0471959111.

Part of the International Programme on Chemical Safety, this volume is a collection of papers presented at a workshop in March 1993. It is concerned with ecological risk assessment and evaluates current knowledge of etoxicology.

ZERO POLLUTION INDUSTRY
Waste Minimisation Through Industrial Complexes

N.L. Nemerow, Wiley, 1995. £45.00. ISBN 0471121649.

This book presents a revolutionary approach to industrial waste management by creating a system of environmentally balanced industrial complexes in which groups of industrial plants consume each other's waste. It anticipates regulations and trends that would factor environmental damage into production costs.

EU ENVIRONMENT GUIDE 1996

EU Committee of the Chamber of Commerce, 1995. BEF 2000. ISBN 2930073195.

The sixth edition of this comprehensive information source on EU environmental policies and contacts. It includes information on the environmental policies and legislative structure of the member states, contents and impact of over 80 EU environmental regulations and information on the structure and function of DG XI. It also covers environmental affairs in the US and global organisations.

FUTURE EVENTS

7 FEBRUARY – Stack Emissions: Monitoring, Modelling & Impact Assessment
Includes papers on emissions monitoring from stationary sources; prcess emission assessment; validation of air dispersion models; quality assurance and control and assessing the impacts of industry on local air quality.
Venue: 14-15 Belgrave Square, London SW1.
Details: Society of Chemical Industry Conference Secretariat, Fax: 0171 823 1698.

7-9 FEBRUARY 1996 - Environmental Mediation and Facilitation: The Essential Course
This full board residential sandwich course, run by The Environment Council, will help participants to understand and develop skills in consensus building.
Venue: Harborne Hall (The VSO Training Centre), Old Church Road, Harborne, Birmingham.
Details: Hally Ingram/Alex Bonner, The Environment Council, Tel: 0171 824 8411.

14 FEBRUARY – Volatile Organic Compounds: Monitoring, Control & Compliance
Fifth in a series of VOC seminars designed to examine this controversial issue. Presentations will include existing and potential legislation; effects on environment and health; solvent management plans; industry sector approaches to reducing and controlling emissions; monitoring, control and abatement. This seminar is endorsed by the Royal Society of Chemistry.
Venue: Forte Crest Hotel, Birmingham.
Details: Sally Bate, IBC Conferences, Fax: 0171 631 3214.

19 FEBRUARY – Contaminated Land
One day conference providing a detailed analysis and description of the contaminated land provisions of the *Environment Act 1995*. A workshop the following day will include a practical drafting exercise of a model form of contaminated land agreement. For those unable to attend either event copies of the conference notes and workshop notes will be available at a cost of £110 and £75 respectively.
Venue: Portman Hotel, London W1.
Details: Sally Bate, Fax: 0171 631 3214. If requesting copy of papers send cheque (payable to IBC UK Conferences Ltd) to Sonia Brant at IBC Gilmoora House, 57-61 Mortimer Street, London W1N 8JX.

26 FEBRUARY - 1 MARCH – Environmental Auditing Course
An interactive five day course including a simulated audit exercise designed to give participants a working knowledge of conducting an environmental audit. This course will

be repeated in the summer of 1996.
Venue: University of Aberdeen.
Details: Jane Butler/Doug Reid, Centre for Environmental Management and Planning, Fax: 01224 487658.

5-6 MARCH – Contaminated Land: Current legislative and financial issues
The *Environment Act 1995* introduces major changes to the way in which contaminated land is regulated and controlled; this conference will address the issues of who is liable for what under the new rules.
Venue: The London Marriott Hotel.
Details: The Waterfront Conference Company Ltd; Fax: 0171 730 0460.

5-8 MARCH – Contaminated Land: Introductory Short Course
This course will provide a broad, comprehensive perspective of the subject, and thus enhance understanding of the different responsibilities of those involved and promote effective liaison; it also aims to improve knowledge of identification techniques, assessment and remedial action.
Venue: Loughborough University.
Details: Rachel Lindley, Centre for Hazard and Risk Management at Loughborough University of Technology, Fax: 01509 610361.

14 MARCH – Renewable Energy '96
Major one day conference will look at the future for renewables at the end of the 20th century, examine the Non Fossil Fuel Obligation and whether it is working.
Venue: Kensington Palace Hotel, London.
Details: Icom Group Conferences, Fax: 0181 642 1941.

15 MARCH – Improving and Managing Urban Air Quality
Subtitled "Challenges for government, local authorities, Department of Health and the transport industry, this confrence will focus on the forthcoming National Air Quality Strategy and the requirements in the *Environment Act 1995* for local authorities to deliver local air quality and the implications for other sectors. This confrence is endorsed by NSCA.
Venue: The Café Royal, London W1.
Details: Neave O'Sullivan/Amanda Jones, IBC, Tel: 0171 637 4383.

26 MARCH – Hazardous Waste Management
One day course providing an update on issues of the moment for managers in the industry and regulatory officers.
Venue: Loughborough University.
Details: Rachel Lindley, Centre for Hazard and Risk Management at Loughborough University of Technology, Fax: 01509 610361.

15-19 APRIL – Diesel Particulates and NOx Emissions
Specialist course for industrial engineers and research workers engaged in the measurement of diesel particualtes and their chemical analysis. NOx reduction techniques

will also be examined in detail.
Venue: Westwood Hall, Leeds.
Details: Miss Julie Charlton, University of Leeds, Fax: 0113 233 2511.

17-18 APRIL – Contaminated Land Remediation
Within the context of new UK guidance on the risk management of contaminated land and developing legislative framework, this course will seek to improve understanding of the requirements for the rational selection of appropriate and effective remediation schemes and promote a critical and robust approach to remediation management.
Venue: Loughborough University.
Details: Rachel Lindley, Centre for Hazard and Risk Management at Loughborough University of Technology, Fax: 01509 610361.

1 JULY - 22 AUGUST – Environmental Assessment and Management
Eight week intensive course (can be attended on a full-time or weekly modular basis) designed to provide a detailed understanding of the principles of EA and of the specific techniques to undertake EA.
Venue: University of Aberdeen.
Details: Jane Butler/Doug Reid, Centre for Environmental Management and Planning, Fax: 01224 487658.

2-3 JULY – Eco-Management and Auditing Conference
Aimed at those interested in corporate environmental management and also of interest to local authorities involved in local initiatives, this conference aims to facilitate in-depth discussion of environmental management systems, associated standards and auditing methodologies.
Venue: University of Leeds.
Details: EMA Conference Organiser, ERP Environment, Fax: 01274 530409.

30 JULY - 2 AUGUST – Inter-Noise 96
Noise - the next 25 years: scientists, engineers and legislators in partnership. Organised by the Institute of Acoustics and sponsored by the International Institute of Noise Control Engineering, this conference will include all aspects of the legislative and technical assessment and control of noise.
Venue: Liverpool.
Details: Institute of Acoustics, Fax: 0181 943 6217.

Forthcoming NSCA Events

Thursday 15 February 1996

NSCA Training Seminar

Noise Nuisance Update

National Exhibition Centre, Birmingham

Noise issues continue to rise up the environmental agenda. New policy developments at European and national level could have a major impact locally. This seminar is for noise consultants, environmental health officers, planners and environmental policy specialists.

Tuesday 26 & Wednesday 27 March 1996

NSCA Spring Workshop

Air Quality Management

Abingdon

A workshop for people who expect to be involved in the local authority air quality assessments required under the 1995 Environment Act, and who are considering subsequent action plans for air quality management areas.

Tuesday 18 June 1996

NSCA Training Seminar

Transport Control Measures
- practical tools for air quality management

National Exhibition Centre, Birmingham

Monday 21 to Thursday 24 October 1996

Environmental Protection 1996

63rd Conference and Exhibition

Brighton